Engineering Library

MAR 15 1927

"THE ENGINEER," FEBRUARY 25, 1927

With METALLURGICAL SUPPLEMENT.

The Engineer.

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Registered as a Newspaper.

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VOL. CXLIII.—No. 3711] LONDON: FRIDAY EVENING, FEBRUARY 25, 1927 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

HOT WATER SERVICE.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 11th March, 1927, for the INSTALLATION of a HOT WATER SERVICE at the Head Post Office, Swansea. Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender, may be obtained from the CONTRACTS BRANCH, H.M. OFFICE OF WORKS, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners of H.M. Works, &c.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 4805

The Director-General, India Store Department, Branch No. 16, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

1. 232 PAIRS DISC WHEELS and AXLES.
2. 645,000 STEEL KEYS.
3. 1650 TONS HEMATITE PIG IRON.
4. 43 LOCOMOTIVE BOILERS.
5. 242 TONS MILD STEEL SHEETS.
6. 329 TONS ROLLED STEEL BEAMS.
7. 110 TONS STEEL SPRING, FLAT, for LAMINATED SPRINGS.
8. 541 TONS MILD STEEL PLATES.
9. 75 TONS GALVANISED MILD STEEL SHEETS, PLAIN and CORRUGATED.
10. 250 TONS IRON, WROUGHT, FIRE-BAR.
11. 1088 TONS MILD STEEL, ROUND, for RIVETS.
12. 2153 TONS MILD STEEL, SECTIONS and BARS.
13. NON-PROPELLING DIPPER DREDGER, length of hull about 94ft.

Tenders due on the 10th March, 1927, for Nos. 1 and 2, on the 11th March, 1927, for No. 3, on the 15th March, 1927, for Nos. 4 to 12, and on the 25th March, 1927, for No. 13.

Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 4816

Wanted at Once, TEMPORARY CIVIL ENGINEERING ASSISTANTS for London Office. Only men with sound theoretical training and recent actual experience in Design Work for Heavy Dock Engineering and Reinforced Concrete Work required.

Preference given to ex-Service men.

Apply, giving full particulars of experience, age, salary required, when disengaged, and enclosing copy of recent testimonials, to CIVIL ENGINEERING-CHIEF, Admiralty, S.W. 1. 4812

Assistant Civil Engineers REQUIRED in Civil Engineer-in-Chief's Department, Admiralty, and H.M. Naval Establishments at home and abroad. Candidates must be between the ages of twenty-five and thirty years on the 16th March, 1927; those who have served or are serving in the Army, Navy or Air Force may deduct from their actual age any time, not exceeding three years, during which they have so served. Candidates must either (a) be Corporate Members of the Institution of Civil Engineers, or (b) have passed Sections A and B of the Associate Membership Examination of the Institution of Civil Engineers or taken a Degree recognised by the Institution as exempting therefrom, and have reached such a stage in their professional training that it is possible for them to become Corporate Members within two years.

Those appointed will be on probation for two years, and will not be confirmed unless and until they, being Corporate Members of the Institution of Civil Engineers, have passed this period of probation to the satisfaction of the Admiralty.

Commencing salary, £250 per annum, plus Civil Service bonus, which at the current rate amounts to £111 per annum.

Special consideration will be given to candidates who served in H.M. Forces during the War.

No candidate will be accepted for appointment who fails to pass a strict medical examination as to his physical fitness.

Forms of application, &c., can be obtained from the CIVIL ENGINEER-IN-CHIEF, Admiralty, London, S.W. 1, and should be returned completed so as to reach that officer not later than the 16th March, 1927.

Candidates will be responsible for any expenses which they may incur in attending for interview. 4806

Assistant Engineers (2) REQUIRED by the RAILWAY DEPARTMENT of the FEDERATED MALAY STATES GOVERNMENT, for four years' service, with possible extension. Salary 400 dollars, rising to 475 dollars a month by annual increments of 25 dollars a month and thereafter in the event of the officer being retained, rising to 800 dollars a month, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar is sterling is at present fixed by the Government at 2s. 4d., but the purchasing power of the dollar in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax is at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 24 to 30, preferably unmarried, must have received a good theoretical training, preferably at an University or a College recognised by the Institution of Civil Engineers and possess a Civil Engineering Degree, or obtained such other Diploma or distinction in Engineering as the Secretary of State may decide in any particular case, or completed their articles with a Civil Engineer of good standing, and have passed the Examination for Associate Membership of the Institution of Civil Engineers. Should have had at least one year's practical experience of Railway Maintenance on a British Railway.—Apply at once by letter, giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting clearly at head of application M/15,162. 4814

Assistant Engineers (4) REQUIRED for the NIGERIAN GOVERNMENT RAILWAY (SURVEY), for a tour of 12 to 18 months, with possible extension. Free passages and a commuted bush travelling and detention allowance of £9 a month whilst on duty in the Colony. Camp equipment provided. Outfit allowance of £60 on first appointment. Liberal leave on full salary. Salary £480 for the first three years of service, then £510, rising by annual increments to £920 a year. Candidates must have passed examination to qualify for A.M.I.C.E. or hold equivalent professional qualifications, and have had experience on Railway Survey, preferably Location.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, mentioning this paper and quoting M/15,135. 4815

The Engineer

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PUBLIC NOTICES

2nd Class Draughtman (Mechanical), experienced. Salary £150-£175 plus Civil Service bonus.

JUNIOR DRAUGHTSMAN (Mechanical). Salary 40s. per week plus Civil Service bonus.

Preference will be given to suitable ex-Service men. Apply by letter to the COMMANDANT, Experimental Station, Porton, Salisbury. 4835

Crystal Palace School of Practical Engineering.
Founded 1872.
MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL: MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors.
Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 4347

The Institution of Chemical ENGINEERS.

EXAMINATIONS for the ASSOCIATE MEMBERSHIP of the INSTITUTION WILL BE HELD in JUNE and JULY NEXT.

Particulars of the examinations and the Memorandum on "The Training of a Chemical Engineer," may be obtained on application to the Hon. Registrar, C. S. GARLAND, Esq., the Institution of Chemical Engineers, Abbey House, Westminster, London, S.W.1.

Applications for entry must be received not later than 1st May, 1927. 4810

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—

(1) TWO 5-TON HAND-POWER TRAVELLING CRANES, with MATCH TRUCKS.
(2) 16,360 MILD STEEL TIE BARS for C.I. POT SLEEPERS (total approximate tonnage equals 230 tons).

Tenders are due in on Tuesday, 15th March, 1927, by 2 p.m. Tender forms obtainable at above address; fee One Guinea each, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender. 4843

PUBLIC NOTICES

Batley Corporation Water-WORKS.
AQUEDUCT FROM BROWNHILL TO STAINCLIFFE.
CONTRACT NO. 2.—STEEL WORK FOR BRIDGES.

The Waterworks Committee invite TENDERS for the MANUFACTURE, DELIVERY, TRANSPORT and ERECTION of the STEEL WORK and IRON-WORK required for EIGHT BRIDGES on the Aqueduct between Brownhill Reservoir, near Holmbridge, and Staincliffe Reservoir at Batley, the total weight involved being about 95 tons.

Drawings may be seen and specification, schedule of quantities, and form of Tender obtained on and after the 28th instant on application to Messrs. G. H. Hill and Sons (Manchester), Civil Engineers, 40, Kennedy-street, Manchester, upon deposit of a cheque for Two Guineas. This sum will be returned to the tenderer provided that he shall have sent in a bona fide Tender, shall have not withdrawn the same, and shall have returned the documents lent to him. Sealed Tenders, endorsed "Tender for Steel Work for Bridges—Aqueduct to Staincliffe," and addressed to the Chairman of the Waterworks Committee, must be forwarded to the Town Clerk, Town Hall, Batley, on or before the 28th March, 1927. The Committee do not bind themselves to accept the lowest or any Tender.

THOS. E. CRAIK,
Town Clerk.

Town Hall, Batley,
17th February, 1927. 4801

The Bengal and North-Western RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

2000 LAMINATED BEARING SPRINGS for WAGONS.
1230 CARRIAGE and WAGON TYRES,

as per specifications to be seen at the Company's offices.

Tenders, addressed to the undersigned, and marked "Tender for Laminated Springs," or as the case may be, with name of firm tendering, to be lodged not later than Noon on the 15th day of March, 1927.

For each specification a fee of 10s. will be charged, which cannot under any circumstances be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
W. R. IZAT,
Managing Director.

238, Gresham House, Old Broad-street,
London, E.C. 2, 23/2/1927. 4848

PUBLIC NOTICES

Royal Show.

NEWPORT
(MONMOUTHSHIRE)
JULY 5th to 9th, 1927.

EXHIBITION OF IMPLEMENTS, &c.

The Regulations and Forms of Application for Space are now ready.

Applications must be made by
MONDAY, MARCH 21st, 1927

Live Stock (except Riding and Driving Horses) entries close on MAY 2nd; Riding and Driving Horses on MAY 31st; Produce and Forestry on MAY 20th; Flower Show on MAY 25th; Poultry on MAY 31st; Plantations, Home Nurseries, Orchards and Fruit Plantations on MAY 2nd; Local classes and Timbering Competition on MAY 31st.

T. B. TURNER, Secretary.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND,
16, Bedford Square, London, W.C. 1.

Great Southern Railways.

The Directors are prepared to receive TENDERS for the SUPPLY, DELIVERY, and ERECTION of about 500 TONS of STEEL WORK required for the Renewal of the Superstructure of a Viaduct about 500ft. long.

The steel work includes 36 Plate Girders, about 54ft. long, with arched plate flooring.

The Directors are prepared to receive ALTERNATIVE TENDERS for the above STEEL WORK SUPPLIED and DELIVERED ONLY.

In addition, TENDERS are INVITED for the SUPPLY and DELIVERY of about 40 TONS of STEEL WORK in Six Small-span Bridges.

There are separate sets of drawings and specifications for the viaduct and for the six smaller bridges. Either set can be obtained on payment of £1 1s. (which is not returnable) from the Chief Engineer, Mr. J. F. Sides, Broadstone Station, Dublin.

The Directors do not bind themselves to accept the lowest or any Tender.

Tenders must reach the undersigned not later than the first post on the 21st March, 1927.

C. E. RILEY, Secretary.

Kingsbridge Station, Dublin. 4850

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. SHEET and PLATE GLASS, &c.
2. BRUSHES.
3. LAMP FITTINGS and GLASSES.
4. SCREWS, BOLTS, NUTS, &c.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Sheet and Plate Glass," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 11th March, 1927.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 2s. 6d. for each copy of Specification No. 1, and of 5s. for each copy of Specifications Nos. 2, 3, and 4.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
22nd February, 1927. 4847

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PUBLIC NOTICES

County Borough of Rotherham.

RECONSTRUCTION OF CHANTRY BRIDGE.

Contractors experienced in the construction of reinforced concrete bridges and retaining walls are invited to TENDER for the RECONSTRUCTION of CHANTRY BRIDGE.

The work will consist of a Reinforced Concrete Highway Bridge, 95ft. skew span and 60ft. wide; 340 Lineal Yards Reinforced Concrete Retaining Walls, about 23ft. high; Dredging 400 Lineal Yards of River Don; Temporary Steel Footbridge, 70ft. span; Restoration of existing 15th Century Bridge and other Incidental Works.

General conditions, specification, bill of quantities and plan of site are obtainable from Vincent Turner, M. Inst. C.E., Borough Engineer, on receipt of details of previous work of this description carried out, and a deposit of Five Pounds, which deposit will be refunded on the return of the documents or on the receipt of a bona fide Tender.

The contract drawings may be inspected at the Borough Engineer's Office, Rotherham, or at Messrs. L. G. Mouchel and Partners, Ltd., 36-38, Victoria-street, S.W. 1.

Sealed Tenders, endorsed "Reconstruction of Chantry Bridge," shall be delivered to the undersigned not later than 10 a.m. on Monday, 21st March, 1927.

C. L. DES FORGES,
Town Clerk.

Municipal Offices, Rotherham,
21st February, 1927. 4823

Civil Service Commission.

POST VACANT.

HYDRO-ELECTRIC DEVELOPMENT OF THE RIVER SHANNON.

APPLICATIONS are INVITED from experienced Engineers for a POST as STRUCTURAL ENGINEER on the Civil Engineering Staff for the above Constructional Works. The remuneration attaching to the post will be £300 per annum inclusive, with possible increases to £400 per annum inclusive.

The appointment, which will be temporary, non-pensionable, and subject to a month's notice on either side, will be made by the Minister for Industry and Commerce on the recommendation of the Civil Service Commissioners, with the assistance of a Board of Selection set up by the Commissioners.

Applicants may be required to attend in person before the Board, and it will be necessary for the successful candidate to satisfy the Commissioners as to health and character.

Further particulars and also form of application obtainable from the SECRETARY, Civil Service Commission, 33, St. Stephen's Green, Dublin. Completed forms of application will be received up to, but not after, first post 11th March, 1927.

82/H5289.

W. H. Co.
4774

Civil Service Commission.

DEPARTMENT OF INDUSTRY AND COMMERCE.

HYDRO-ELECTRIC DEVELOPMENT ON THE RIVER SHANNON.

POST VACANT.

APPLICATIONS are INVITED from experienced engineers for the following POST on the Mechanical Staff in the Erection of the Hydraulic Equipment of the Power Station :—

MECHANICAL ENGINEER.

Inclusive salary £600, with probable increases to £700 per annum. Candidates must hold a University Degree in Mechanical Engineering or an equivalent qualification, and must have at least 5 years' experience on the erection and tests of heavy hydraulic machinery and equipment (turbines, penstocks, sluices, &c.). Experience in the erection of electrical machinery (not including testing) will be an additional qualification.

The appointment, which will be temporary, non-pensionable, and subject to a month's notice on either side, will be made by the Minister for Industry and Commerce on the recommendation of the Civil Service Commissioners, who will investigate the qualifications of the candidates with the assistance of a Selection Board appointed by the Commissioners.

Further particulars and form of application obtainable from the SECRETARY, Civil Service Commission, 33, St. Stephen's Green, Dublin. Latest date for receiving application 1st March, 1927.

82/H5298.

W. H. Co.
4773

Madras and Southern Mahratta RAILWAY.

ASSISTANT CIVIL ENGINEER.

REQUIRED for service on the Company's Railway in India, TWO ASSISTANT CIVIL ENGINEERS, 24 to 33 years of age, and preferably unmarried, who must be Associate Members of the Institution of Civil Engineers, or possess the degree in civil engineering of a recognised Engineering College or University.

Candidates must have had some experience of constructional work with a railway company or public works contractor.

TERMS.—A first-class free passage to India and return on satisfactory termination of services, and a three years' agreement, which may be continued if agreeable to both parties.

SALARY.—Rupees 525 to 975 per calendar month, according to age and experience.

The selected candidates will be required to pass a strict medical examination before appointment.

Applications (by letter only), giving full particulars of general and technical education, honours gained (if any), age, whether unmarried, and details of practical experience, in chronological order (with dates), together with COPIES ONLY of testimonials, must be addressed not later than 11th March, 1927, to

THE SECRETARY,
Madras and Southern Mahratta Railway Co., Ltd.,
25, Buckingham Palace-road,
Westminster, London, S.W. 1.

23rd February, 1927. 4860

Singapore, Straits Settlements.

ELECTRICITY DEPARTMENT.
CHARGE ENGINEER.
ADVERTISEMENT.

The Municipal Commissioners of Singapore REQUIRE an additional CHARGE ENGINEER for their new Power Station.

The capacity of the plant installed in the first instance is 12,000 kilowatts.

Candidates should have a thorough experience in extra high-tension three-phase generation, steam turbines, water-tube boilers, and mechanical stokers, and must have held a similar position for at least two years.

The appointment will be on a three years' agreement, with possible extension, the salary being 5100 dollars per annum for the first year, with annual increments of 300 dollars. The Straits dollar has a fixed value of 2s. 4d. The pay of the appointment for the first year at the above-mentioned rate is £595.

Free passage will be provided, with half pay during the voyage out. A medical certificate as to fitness for service in the tropics will be required from each selected candidate.

Applications, stating age, place of birth, whether single or married, and giving details of education, training and experience, accompanied by copies (not originals) of testimonials, and the names of three personal references, must be lodged with the undersigned (from whom further information can be obtained), not later than 3rd March, 1927, PEIRCE and WILLIAMS, MM. Inst. C.E., 64, Victoria-street, London, S.W. 1, Agents to the Municipal Commissioners. 4811

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, a STRUCTURAL ENGINEER, to Fill a SENIOR POST with a British Firm in India, who have Structural Steel and General Engineering Works. Should have A.M.I.C.E. or equivalent qualifications. Must have had good technical training, also drawing-office and workshop experience. Age 30 to 35.
Good salary and prospects to a suitable man.
Address, P2852, The Engineer Office. P2852 A

WANTED, TRAVELLER for Drop Forgings, London and Home Counties. Good experience of this work essential. Connection desirable.—Address, 4803, The Engineer Office. 4803 A

ASSISTANT MECHANICAL ENGINEER WANTED. University graduate, highest qualifications, some works experience. Under 30 years of age.—Apply, giving age, university career, experience, &c., to TECHNICAL MANAGER, British Dyestuffs Corporation, Limited, P.O. Box 42. 4849 A

ASSISTANT SUPERINTENDING ENGINEER REQUIRED for Fleet of Tank Steamers. Applicants must have knowledge of all classes machinery, including Reciprocating, Steam Turbines and Diesel Machinery, also Ship Construction. Drawing-office experience essential. Applicants must not be under 30 years of age.—Address applications (treated confidentially), stating age, references, salary required, when at liberty, P2857, The Engineer Office. P2857 A

CHIEF TEST PLATE ENGINEER, Internal Combustion Engines, wide experience and familiar with latest heavy oil engine practice. Sound general and technical education. State age, salary, when at liberty.—THE CAMPBELL GAS ENGINE CO., Ltd., Halifax. 4816 A

ENGINEER, Aged 30 to 45, REQUIRED, to Take Control of Plant, Power and Premises of Large Engineering Works in the London district. Must be thoroughly experienced in the maintenance and repair of all classes of Machine Tools, also Lighting, Heating, and Power Plant.—Address, stating age, full details of experience (with copies of references), and salary required, 4831, The Engineer Office. 4831 A

ENGINEER for Small Repair Works, East London. Gas and oil engine and general repairs, plans, estimates, arrange and supervise work. State salary, age, and experience.—Address, P2804, The Engineer Office. P2804 A

ENGINEER-SALESMAN REQUIRED to Reside in London and act as Agent. Must have experience in the Construction and Sale of Railway Rolling Stock, including coach work. Also in Structural Steelwork for Bridges and Buildings. Some knowledge of German. State age, references, details of training, manufacturing and selling experience and salary required.—Address, 4864, The Engineer Office. 4864 A

ENGINEER WANTED, with Good Experience in the design, manufacture and testing of Two-stroke Cycle Oil Engines up to 200 H.P., to Take Charge of Department. Must have had sound experience in responsible position. Give full particulars and state salary required.—Address, 4802, The Engineer Office. 4802 A

EXPERIENCED ENGINEER WANTED; Age 30 to 35. B.Sc. degree and Works or Construction experience essential.—Apply in writing to BRUNNER, MOND and CO., Limited, Northwich, Cheshire. 4862 A

MANAGER for Old-established Nut and Bolt Works, neighbourhood Manchester; present turnover approximately £150,000. Must have good experience of trade and be known to large buyers. Commencing salary and commission approximately £1000.—Address, in confidence, stating age, experience and other qualifications, to P2862, The Engineer Office, P2862 A

MECHANICAL ENGINEERING ASSISTANT, with practical experience of Iron and Steel Plant, Processes and Production. Age 25 to 30.—Apply, giving particulars education, training and experience, and salary required, to the SECRETARY, the National Federation of Iron and Steel Manufacturers, Caxton House, Tothill-street, Westminster, S.W. 1. 4826 A

PREMIUM PUPIL.—Engineer and Contractor, with Old-established Business, has an OPENING for a well-educated YOUTH in his London Office. Would be given a thorough training and offered a responsible post when proficient.—Address, P2864, The Engineer Office. P2864 A

QUALIFIED ENGINEER, with Exp. in Reinforced Concrete, REQD. IMMED. for Far East. Age 24/30, single. Com. sal. £500/600, 3 years' agree.—Apply, COOPER and CO., Employment Specialists, 78, Old Broad-street, E.C. 2. P2858 A

WORKS MANAGER REQUIRED for Small Engineering Works, London. Experience modern methods of production essential. Energetic and reliable. State salary desired and give references.—Address, 4861, The Engineer Office. 4861 A

YOUNG ENGINEER WANTED; Age not More than 26, B.Sc, Degree and Works or Construction experience essential.—Apply in writing to BRUNNER, MOND and CO., Limited, Northwich, Cheshire. 4863 A

WANTED IMMEDIATELY in London, DRAUGHTSMAN, with experience in Central Power Station Design; electrical experience desirable.—Address, stating age, experience, and when free, P2832, The Engineer Office. P2832 A

WANTED, JUNIOR DRAUGHTSMEN for Crane and Conveyor Work in large works in Leicestershire.—Address, stating age, qualifications, when at liberty, and salary desired, to 4719, The Engineer Office. 4719 A

WANTED, TURBINE DRAUGHTSMAN, Used to Lay-out and Design of Impulse Turbines. Only first-class men need apply.—State age, experience, and salary to W. H. ALLEN SONS and CO., Ltd., Bedford. 4856 A

CHIEF DRAUGHTSMAN, Having a Thorough Locomotive and Electrical experience, with practical and theoretical knowledge of the Internal Combustion Engine.—Apply, giving full particulars and testimonials (copies only), to NORTH BRITISH LOCOMOTIVE CO., Ltd., 110, Flemington-street, Springburn, Glasgow. P2815 A

CHIEF DRAUGHTSMAN WANTED for Old-established firm of Locomotive Builders. Must be good organiser and conversant with Industrial Tank Locomotives. Send full particulars.—Address, 4808, The Engineer Office. 4808 A

DRAUGHTSMAN, Senior, REQUIRED for Baum Washeries, competent to design all details with minimum supervision. Only experienced men need apply. Midlands. State age, salary, full details.—Address, 4857, The Engineer Office. 4857 A

DRAUGHTSMAN, Specially for Centrifugal Pumps, low and high lift, and with a knowledge of Steam and Power Pump. State age, experience, and salary required.—Address, 4824, The Engineer Office. 4824 A

FIRST-CLASS DRAUGHTSMAN REQUIRED, Experienced in all types of Electric and Steam Cranes.—Apply, giving full particulars of experience, age, and salary required, to THOMAS SMITH and SONS (RODLEY), Ltd., Rodley, Leeds. 4854 A

FIRST-CLASS LEADING MECHANICAL DRAUGHTSMAN REQUIRED in Kent for about 12 to 18 months. Expert knowledge of Elevating and Conveying Machinery essential. Cement plant experience an advantage. State age and salary.—Address, 4852, The Engineer Office. 4852 A

SITUATIONS OPEN (continued)

HEATING ENGINEER.—Good Opportunity for Junior Draughtsman, preferably with some experience in Heating Practice.—Write, stating experience, age, and salary required, to HENRY HOPE and SONS, Ltd., 59, Berners-street, W. 1. 4853 A

JUNIOR DRAUGHTSMAN REQUIRED IMMEDIATELY; some experience Structural Work, Piping and General Arrangement, Boiler Plant; good knowledge detail. Must be neat and accurate.—Address, P2854, The Engineer Office. P2854 A

LARGE and Old-established FIRM of CONSTRUCTIONAL ENGINEERS in India REQUIRE a STRUCTURAL DRAUGHTSMAN, age under 23, unmarried.—Reply, giving fullest details education, engineering experience, present class of work and present salary, to Box Z.H. 712, c/o Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 4859 A

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Limited, Trafford Park, Manchester, REQUIRES TRANSFORMER DRAUGHTSMEN with experience in large and small Core Type and also, preferably, Shell Type Construction.—Applications in writing, stating age, nature of training and experience, and salary required, should be addressed to the COMPANY'S EMPLOYMENT DEPARTMENT, marked "Transformer Draughtsmen." 4840 A

SENIOR DESIGNERS WANTED for London Office of Steel Constructional Engineers. Must be accustomed to Steel-framed Buildings. State age, experience, and salary required.—Address, P2851, The Engineer Office. P2851 A

STRUCTURAL DRAUGHTSMAN REQUIRED by British Firm in India; must have had good technical training, be able to work out stresses, prepare designs, estimates, and detail drawings of Roof, Bridge, and General Structural Steel Work. Must be a bachelor, age 23 to 27.—Apply, stating age and particulars of experience, to Z.L. 736, care Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 4858 A

STRUCTURAL STEEL DESIGNER, Under 30, REQUIRED for Bombay.—Send application, with copies testimonials, salary, &c., required, to BRITISH INSULATED CABLES, Ltd., Prescot. 4825 A

TWO JUNIOR DRAUGHTSMEN REQUIRED, with experience in Constructional Engineering. State age, experience, salary.—Address, P2836, The Engineer Office. P2836 A

THOROUGHLY Practical and Experienced FOREMAN REQUIRED for Ironfoundry; 10 tons weekly. Must be able to produce accurate repetition castings at a competitive cost. State age, experience, and salary required.—Box No. 677, W. S. Crawford, Ltd., 233, High Holborn, W.C. 1. 4817 A

SITUATIONS WANTED

A MARINE ENGINEER, with Knowledge of Shipbuilding and repairs, DESIRSE POST; 20 years' experience and wide business connection; energetic and strict disciplinarian; accustom to estimating and supervising work, also interviewing shipowners and superintendents.—Address, P2805, The Engineer Office. P2805 B

ADVERTISER, Having Held Successfully Managerial positions (light and medium engineering), is OPEN to CONSIDER OFFERS where energy and ability to obtain accurate production economically is required.—Address, P2843, The Engineer Office. P2843 B

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MR. FLETCHER WILSON, LL.B., Chartered Patent Agent, High-street Chambers, Coventry, HAS a VACANCY for an ARTICLED PUPIL. P2841 E

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

French Naval Construction.

A LARGE batch of contracts for vessels to be built under the current French navy estimates has recently been placed. Private yards have secured most of the work, and in order to alleviate unemployment the keels of all the ships will be laid at the earliest possible date. A 10,000-ton cruiser—the fourth of this class to be authorised—is to be built at Brest, a submarine cruiser at Cherbourg, and a submarine minelayer at Toulon. Private firms have booked orders for three flotilla leaders of 2700 tons, four destroyers of 1700 tons, and five submarines. The only contracts outstanding are those for a training cruiser, a submarine depôt ship, and two naval tankers, all of which are expected to be built in non-Government yards. An opportunity of inspecting the latest specimens of French naval architecture will be afforded by the visit of a powerful squadron to Spithead at the end of May. It is to comprise the new cruisers Duguay-Trouin, Lamotte-Picquet, and Primauguet, sister ships of 8000 tons and 34·5 knots; three flotilla leaders of the "Chacal" class, and the same number of destroyers of the "Simoun" class. All these nine vessels were launched in 1923–25 and are therefore of the most modern design. The cruisers are comparable with the British "E" class, though somewhat superior in tonnage, speed, and armament, but we have nothing to compare with the big French flotilla leaders, which are unique in fighting power. The squadron, which will be commanded by Rear-Admiral Pirot, is expected to remain at Spithead five days.

Naval Limitations.

FRANCE and Italy have definitely refused the American proposal for a new conference on the limitation of naval armaments. The French Government takes the attitude that land, sea, and air armaments should be considered as a whole, and further contends that negotiations for the restriction of naval weapons alone would stultify the labours of the League of Nations, which has long been endeavouring to find a formula for the universal regulation of all armaments. The Italian Government, while putting forward similar objections, lays special stress on the need of an adequate force of light naval vessels for the protection of Italy's vital sea routes. Japan has accepted the invitation, but with the request that the discussion shall not open before June 1st, and with an expression of satisfaction "that it is not the intention of the United States Government at this time to put forward rigid proposals on ratios of naval strength." The British reply has not yet been sent, as it was necessary that the Imperial Government should consult the Dominions before responding to the American note. Meanwhile it is being made clear in official circles at Washington that the object in view is the limitation rather than the reduction of fleets. Apparently, therefore, the United States will not propose the curtailment of existing programmes or the scrapping of ships already completed or building, but will content itself with suggesting a maximum ratio of tonnage for cruisers, destroyers, and submarines. As, however, France and Italy are standing out, it is clear that any agreement which may be reached will apply only to the navies of the British Empire, the United States, and Japan.

Standardisation on the Southern Railway.

AT the annual general meeting of the Southern Railway Company, held in London on Tuesday, February 22nd, the chairman, Brig.-General the Hon. Everard Baring, gave some account of the efforts made to achieve standardisation, a factor on which, he said, the success of railway amalgamation largely depended. When the Southern Railway was formed four years ago, General Baring remarked, it represented the amalgamation of three entirely separate undertakings, each with its own organisation, methods of construction and operation, its own ideals and prejudices. To-day, he claimed, the three units had been blended into one entity and all the departments were working in absolute accord with each other. When the amalgamation took place the constituent companies between them had no fewer than 135 different types of locomotives. Elimination of unnecessary types was proceeding gradually and nine designs had been produced to meet the requirements of the line. All new engines would be built to these standard designs, many of the important parts of which would be interchangeable. Similar simplification was being effected in the carriage and wagon departments. Standardisation on the electrified sections of the line was also being secured by converting the Brighton Company's division from its original single-phase overhead system to the direct-current 600-volt third-rail system adopted by the South-Western division from the outset and, almost at the last moment, by the South-Eastern division. When various additional schemes of electrification now in hand were completed the company, General Baring added, would have electrified 264 route miles, equivalent to 732 single track miles, within its suburban areas. That figure would represent 17 per cent. of its total track mileage. The results of the electrification carried out had been so satisfactory that further extensions were at present being considered. Electrification of the line to Brighton and other points on the coast is, it would appear, from a supplementary remark made by the chairman, not being contemplated as an undertaking for execution in the immediate future.

The Transport of Coal.

THE appointment of a new body to be known as the Standing Committee on Mineral Transport is announced by the Minister of Transport and the Secretary for Mines. The duties of this body will be to review the equipment available for the transport of coal from the coalfields to the ports and inland markets and the methods of conducting such transport. The Committee is to pay special attention to the recommendations made by the Royal Commission on the Coal Industry (1925), and is to devise means of promoting such improvements in transport equipment and its use as will lead to the greatest efficiency and economy in transport, and be of mutual advantage to the coal mining industry and the transport agencies. It is to report to the Minister and Secretary upon the steps taken and upon any further measures required to bring about desirable alterations, and generally to watch over the matter and the progressive realization of the economies and improvements which the report of the Royal Commission considers possible. The Committee will be under the chairmanship of Sir Arthur Duckham, and will consist of eighteen members who, among them, will represent the railway companies, the Ministry of Transport, the Mines Department, transport labour organisations, coal owners, coal merchants, and coal exporters, wagon builders and hirers, and dock authorities.

The Rationalisation of Industry.

SPEAKING in Leeds last week, Sir Alfred Mond made a strong plea for what he called the "rationalisation" of industry, by which he meant increased co-operation between great industries, and the pooling of their ideas and knowledge. The grouping together of industries into units of a size which at one time would have been regarded as unworkable and uncontrollable was, Sir Alfred said, one of the economic phenomena of the business world of to-day. Great combinations could regulate the means of production and prices in a manner which enabled the consumer to lay his plans for years ahead with some kind of certainty. The rationalisation of industry prevented industrial depression and shortages and undue rises and falls in prices. The difference between slumps and booms was rarely more than 10 per cent. That 10 per cent. was, under present conditions, being allowed to govern the world, to create fortunes, to cause great losses, and to disorganise the life of the community. The steel industry of this country in particular required rationalisation. In its present disunited condition it could not compete against the great United Steel Corporation in America or the great German steel combine representing the amalgamation of a hundred firms. People nowadays wanted to negotiate with an industry and not with individuals in different towns. In the textile industry, by way of contrast, there were such bodies as the Bradford Dyers' Association, the British Cotton and Wool Dyers, the Calico Printers' Association, and the Bleachers' Association, in each of which a large number of firms were concerned. It might be said that such big combinations as those which he was recommending could not easily be managed. His experience was that it was the small business that gave the most trouble.

Shipbuilding and Trade Facilities Act.

AT the House of Commons on Thursday last, February 17th, a joint deputation representing the Shipbuilding Employers' Federation and the Shipyard Trade Unions, waited upon the Prime Minister to urge the Government to continue the provisions of the Trade Facilities Act with regard to credits for the British shipbuilding industry. While receiving the deputation with sympathy, Mr. Baldwin explained the reasons which have led the Government to the decision to discontinue the scheme. He added that he could not hold out any hope that this decision would be reconsidered.

Smoke Abatement.

THE Public Health (Smoke Abatement) Act, 1926, comes into force on July 1st this year, and in connection with it a circular concerning its provisions and administration has been sent by the Ministry of Health to local authorities. The circular recalls that the principal provisions give the authorities power to take proceedings with respect to a nuisance from smoke which is not black, extend the meaning of the word "smoke" to include soot, ash, grit and gritty particles, and give power to make by-laws prescribing standards as to the emission of smoke. The new Act, the circular states, will give local authorities useful additional powers and by careful administration and co-operation will enable much more than formerly to be done to reduce the emission of smoke. At present, according to the advice received by the Minister, it is not practicable to apply standards to any but black smoke. Under the appropriate section of the Act it will be possible to make a by-law which will provide that a nuisance will be presumed if black smoke is emitted for an aggregate of two minutes within any continuous period of thirty minutes. The Minister holds that by-laws of this nature should be made by the local authorities in every considerable industrial district, although he recognises that it may not be considered practicable to apply such a strict standard immediately. With the co-operation of bodies representing industrial interests, it is believed that much will be done with the aid of the Act to reduce the smoke evil.

Indian Iron and Steel.

SIR WILLIAM J. LARKE, K.B.E., Director of the National Federation of Iron and Steel Manufacturers, commenting on Tuesday last on the passage through the Indian Legislature on Monday of the Steel Protective Bill amending the Indian iron and steel tariffs, to give effect to the recent recommendations of the Indian Tariff Board, stated that the effect of this measure would undoubtedly be to facilitate closer co-operation between the British iron and steel industry and the Indian iron and steel industry in the interests of both. This measure, he said, placed British industry in a position more nearly approaching equality in competition with continental industries for supplying Indian needs. It could not be too clearly recognised, he continued, that the measure which had now become law in India was not a measure of Imperial Preference. It was the result of the most careful and impartial inquiry conducted by a Tariff Board consisting entirely of Indian members, who, quite apart from any political considerations, with a single-minded appreciation of the economic needs of India, had presented what must be considered as one of the most far-sighted and statesmanlike reports, published in recent times, on an industrial development and its relation to the needs of the country concerned. He felt confident that the result of this report, to which the Legislature had given statutory effect, would be the development of the Indian iron and steel industry in the future, on the most efficient and economic basis, and this development would be assisted by co-operation with the British iron and steel industry, which this legislation tended to render more effective by placing the British iron and steel industry on an equality with those of other countries in the Indian market.

An Important Oil Engine Development.

WE are in a position to state that the Worthington Pump and Machinery Corporation of New York has granted to Carels', of Belgium, now known as the Société d'Electricité et de Mechanique (Procédés Thomson-Houston et Carels), Ghent, Belgium, a licence for the construction of the Worthington type of oil engine for both land and marine purposes. The licence is an exclusive one as regards Belgium, and is non-exclusive for certain European countries, South America, China, and some parts of the British Empire. The largest engines of this type yet built are the four-cylinder two-cycle double-acting units, with a bore of 28in. and a stroke of 40in., and a designed output of 2050 S.H.P. at 95 r.p.m., which are installed and are running successfully in the American-owned motor ships Tampa and Unicoi. We understand that designs for an engine of larger output with cylinders of about 34in. diameter and 48in. stroke, capable of giving an output of 2000 S.H.P. per cylinder, are now being considered by the Worthington Corporation. In Great Britain the Worthington engine is in the hands of Worthington-Simpson, Ltd. In America the Carels engine is constructed by the Nordberg Manufacturing Company of Milwaukee. It is certainly interesting that the Ghent firm should be the first continental licensee for the new Worthington design.

The Beet Sugar Industry.

AT the twelfth annual meeting of the British Beet Sugar Society, Ltd., which was held in London last week, Mr. G. H. Roberts gave some interesting figures concerning the steady growth of this new British industry. Four additional beet sugar factories were completed last year, and there were fourteen factories in operation during the season. During the present year two new factories would be completed, one at Bardney, in Lincolnshire, and the other at King's Lynn. Other factory schemes are under consideration for Selby, in Yorkshire, and Allscott, in Shropshire. In 1924 the area of sugar beet grown was 22,634 acres, which increased to 54,750 acres in 1925 and 125,000 acres last year. The output of sugar for the year 1924 was 23,761 tons; 51,140 tons of sugar were produced in 1925, and last year's total is expected to reach a figure not far short of 130,000 tons, which represents five weeks national sugar consumption. The industry had been criticised on the ground of its Government subsidy, but Mr. Roberts suggested that it was wise to subsidise an industry which had a prospect of ultimately establishing itself. The companies which owned the factories were co-operating with Government Departments with a view to discovering proper methods of treating factory effluents.

Delaware River Suspension Bridge, U.S.A.

No. I.

THE largest suspension bridge ever built, which has a span of 1750ft., was added to the list of great engineering structures on July 1st, 1926, with the formal opening of the American bridge across the Delaware River, to connect the opposite cities of Philadelphia and Camden. Besides a roadway and footways, it carries an electric tramway and the electric trains of the Philadelphia underground railway. A general view of the bridge is given in Fig. 1, while an elevation and plan appear in Fig. 2.

In this great bridge the main span is 150ft. longer than that of the Williamsburg Bridge at New York, which is comparable with it as to traffic conditions, and it is 118ft. longer than that of the Bear Mountain Bridge over the Hudson River, which is for highway traffic only. The Philadelphia bridge is operated as a toll bridge, the tolls being assigned for maintenance charges and to build up a sinking fund to redeem the bonds issued to provide money for the construction cost.

This new structure takes its place as second in the list of the world's longest bridge spans. The Quebec Bridge over the St. Lawrence River continues to head that list with its cantilever span of 1800ft.; the Delaware River Bridge comes next with a suspension span of 1750ft., and the Forth Bridge now ranks third, with its two cantilever spans of 1710ft. In the list of some of the longest spans, as given below, the last four cross the East River at New York :—

Long-span Bridges.

			Feet.
1917	Quebec Bridge, Canada	Cantilever	1800
1926	Delaware River Bridge, U.S.A.	Suspension	1750
1890	Forth Bridge, Scotland	Cantilever (two)	1710
1924	Bear Mountain Bridge, U.S.A.	Suspension	1632
*	Sydney Harbour, Australia	Cantilever	1600
1903	Williamsburg Bridge, U.S.A.	Suspension	1600
1883	Brooklyn Bridge, U.S.A.	Suspension	1595½
1909	Manhattan Bridge, U.S.A.	Suspension	1470
1909	Queensboro Bridge, U.S.A.	Cantilever (two) and	1280 984

* Under construction.

The two American cities of Philadelphia, Pennsylvania—population 2,000,000—and Camden, New Jersey—population 135,000—face each other across the Delaware River, which not only separates the cities but also forms the boundary between the two States. Thus joint action of two State Governments was necessary, with the Federal or national Government in addition, since it has control over all navigable streams. The Delaware is an important navigable river, serving the port and naval dockyard at Philadelphia, about 40 miles above Delaware Bay, and nearly 100 miles from the Atlantic Ocean. Comparatively few ships of the larger class, however, come as far up the river as the site of the new bridge. In passing the cities the river, flowing southward, is practically straight, with a width of 1700ft. to 1800ft. between the harbour lines and with a depth of about 50ft. of water. On the west, or Philadelphia, side the ground rises from the shore line, but on the Camden side it is low and flat.

Until 1926 large steam ferry boats were the only means of communication for passengers and highway vehicles between the two cities, and there was no highway bridge over the river nearer than Trenton, 33 miles upstream. In addition to the ordinary local traffic between two such closely adjacent cities, there is an enormous railway and highway—motor vehicle—traffic from Camden to the several large and popular resort cities which line the Atlantic coast of New Jersey. By far the greater proportion of this traffic comes from Philadelphia locally, and through it by the railways and highways centring at that city. As a result, the delay and inconvenience of transportation to and across the ferry to reach the Camden railway terminus and main highways had become increasingly objectionable, with the growth of traffic, which reaches a high peak during the summer season.

There had long been a demand for some more convenient and direct means of communication, in consequence of which numerous bridge and tunnel projects for the linking of the two cities blossomed, bloomed and withered during the past twenty-five or thirty years. But in 1919 a definite step was taken in the appointment by the two State Governments of a joint commission organised for the purpose of investigating and carrying out a project for a bridge over the river. An amazing step in the early promotion preliminaries, which would have been amusing also except for its possibilities of danger or failure, was the demand by certain non-technical and ill-informed officials that this great bridge, having of necessity an exceptionally long span, should be designed by an architect in order that a "beautiful" structure might be obtained. It is needless to say that no architect could have been found who was competent to design such a bridge or to decide what type of bridge should be adopted, a structure of this kind being quite outside the architectural field. After the adoption of the type and the preparation of the general engineering design, however, an architect was employed appropriately to plan the treatment of the entrances, the massive anchorages and other parts accessory to the engineering structure.

A board of three engineers charged with making a traffic census, a survey of possible sites and a general plan for a bridge, was appointed in 1920 by the Pennsylvania and New Jersey Joint Commission. Mr. Ralph Modjeski, the noted bridge engineer, was made chairman; Mr. George S. Webster represented the State of Pennsylvania; and Mr. L. A. Ball represented the State of New Jersey. Trial borings to determine foundation conditions were begun early in 1921. They showed gneiss rock overlaid by 20ft. to 35ft. of disintegrated rock and clay to the surface stratum of earth. The report of this board of engineers, recommending a structure essentially identical with the bridge as now completed, was accepted and approved by the Commisson in June, 1921. The board estimated that the bridge could be completed in July, 1926, or in five years, and that was actually accomplished, in spite of unexpected delays resulting from controversies in the Commission between representatives of the two States.

Following the approval of the report, the members of the board of engineers were reappointed as the heads of a permanent engineering staff. Mr. Modjeski, as chief engineer, was the ruling spirit, acting in close co-operation with Mr. Webster and Mr. Ball. Mr. Clement E. Chase was principal assistant engineer; Mr. Leon S. Moisseiff, engineer of design; Mr. Charles Carswell, assistant engineer; Mr. M. B. Case, senior resident engineer; Mr. Daniel E. Moran, consulting engineer for foundation work; and Mr. Paul Cret, architect.

Factors considered in determining the position or site of the bridge included the following:—Relation to business centres and points of concentration of cross-river traffic; practicable approaches; local obstacles, such as railway termini and goods yards; foundation conditions; and present and probable future traffic conditions, both as to amount and direction. Traffic in 1920 aggregated 2,500,000 highway vehicles and 48,000,000 passengers by the several ferries, but the Market-street ferry carried about 61 per cent. of the vehicles and 77 per cent. of the passengers. Of passengers going to Camden, about 25 per cent. went to the railway terminus. It was estimated on the basis of this census that the maximum one-hour vehicle peak traffic would reach 2000 in 1926 and 3000 in 1931.

A clear span of 1750ft. to avoid any piers or obstructions between the established harbour lines was a fundamental condition imposed by the United States War Department, which, as already mentioned, has control over navigable streams. As to overhead clearance for navigation, a headway of 135ft. above high water for a width of 800ft. over the middle of the river channel was proposed, and was accepted by the shipping interests, with little opposition. It was then approved by the engineers of the War Department. The several bridges over the East River, at New York, have a clearance of 135ft., except that the Brooklyn Bridge gives only 133ft. Many large commercial steamers, sailing ships and naval vessels navigate the East River, which has a navy dockyard situated above three of the bridges. At Philadelphia there is a navy dockyard a long way below the Delaware River bridge, and in 1920 all the steamers and nearly all the sailing vessels using this port could have passed the proposed bridge with the clearance limit as recommended. As a matter of fact, most of the sailing ships and 80 per cent. of all the shipping are berthed below the bridge site.

General Description of Bridge.—In general, then, the Delaware River bridge as built, practically in accordance with the original design submitted in 1921, is a suspension bridge having a main span of 1750ft. over the river, and shore spans of 719½ft., with a total length of 3450ft. over the cable anchorages. Street and approach conditions enabled the side or shore spans to be made about half the length of the main span, which is a desirable proportion for effective design and good appearance. Over the river there is a minimum headroom of 135ft. for a distance of 800ft. at the middle of the span. Including the viaduct

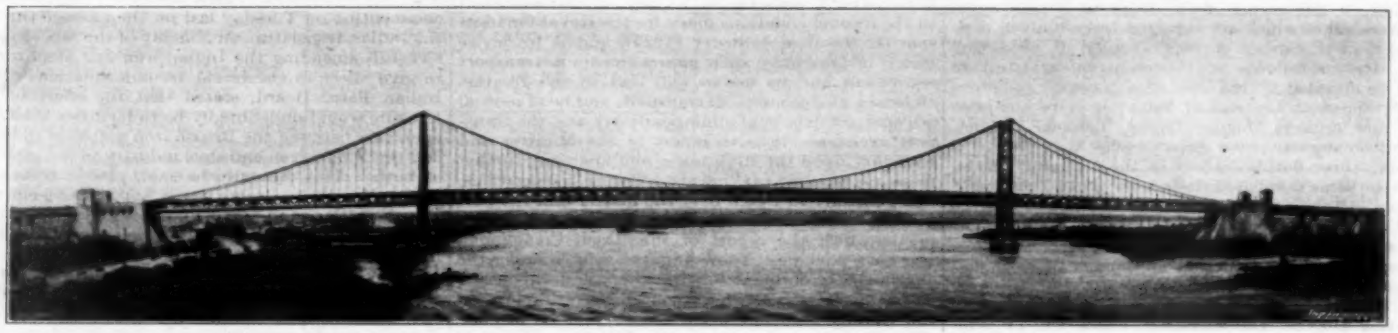


FIG. 1—SUSPENSION BRIDGE OVER THE RIVER DELAWARE

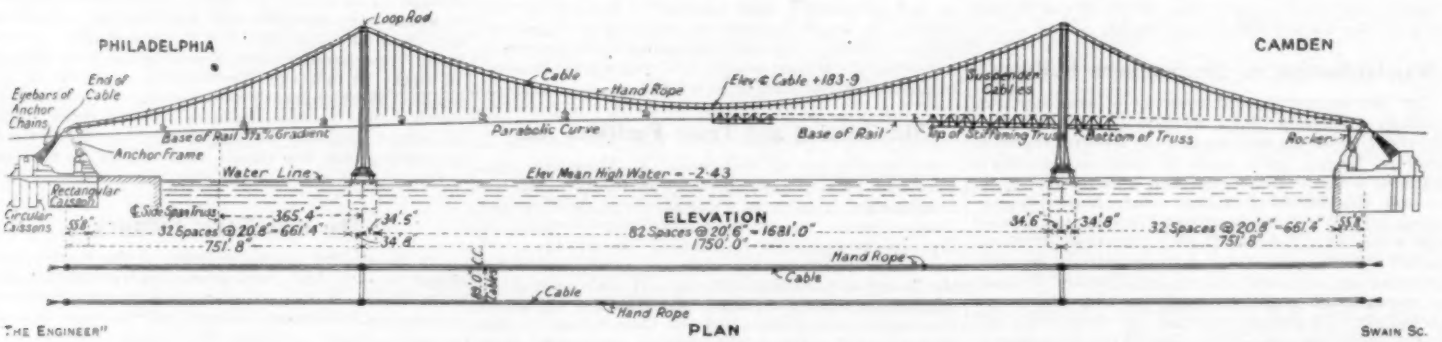


FIG. 2—ELEVATION AND PLAN OF THE BRIDGE

approaches, the total length of the bridge is about 2 miles.

On the three suspension spans the deck is carried by suspender ropes from two huge wire cables, 30in. in diameter, and spaced 89ft. apart between centres. These cables are led over two steel towers, 380ft. high above the water, but instead of resting on movable saddles mounted on rollers, as in most of the earlier bridges, the saddles are anchored rigidly in place, so that the towers must lean to compensate for relative movements of the cables in the central and side spans. Two cables were considered preferable to four, as used in other suspension bridges of comparable size. This plan necessitated the unprecedented size of 30in. in diameter for the two cables, as contrasted with four of 15¾in. in diameter for the Brooklyn Bridge, four of 18¾in. diameter for the Williamsburg Bridge, and four of 20½in. diameter for the traffic over the bridge, extended study was made as to the most suitable arrangement, width and carrying capacity of the roadway. The adopted design, as compared with that of four of the great bridges over the East River at New York is shown in Fig. 3. It was found that on the New York bridges traffic conditions were unsatisfactory with separate two-lane roadways for the two directions of traffic, as on the Brooklyn and Williamsburg suspension bridges; and also with a single roadway, 35ft. wide, for four lines of vehicles, as on the Manhattan suspension bridge. On the other hand, the single roadway, 53ft. wide, designed to carry six lines of vehicles, as on the Queensboro cantilever bridge, was found to give ample capacity and flexibility in the movement of traffic. For the Philadelphia bridge, therefore, it was decided to provide a single roadway sufficient for six lines of travel, but to allow greater freedom of movement the width was made 57ft. between the kerbs.

cables, but the longest bridge of this type—at Florianopolis, Brazil—has a span of 1113ft. 9in., and is for light loading only. This bridge, designed and built by American engineers in 1924, carries only a 28ft. roadway with a single line of metre-gauge electric tramway in the middle, and a 10ft. walk on cantilever brackets along one side. The load due to this footwalk is balanced by a cast iron water main laid along the farther side of the roadway. Each of the two chains is composed of four 12in. eye-bars, 1¾in. to 2in. thick, with a length of 20ft. 8in. between centres of the 11½in. pins. The shore ends of the chains act only as backstays, carrying no suspenders.

The difference between this structure and the proposed Delaware River bridge was such that the former could hardly be taken as an argument for the use of chains for the latter. On the other hand, a strong

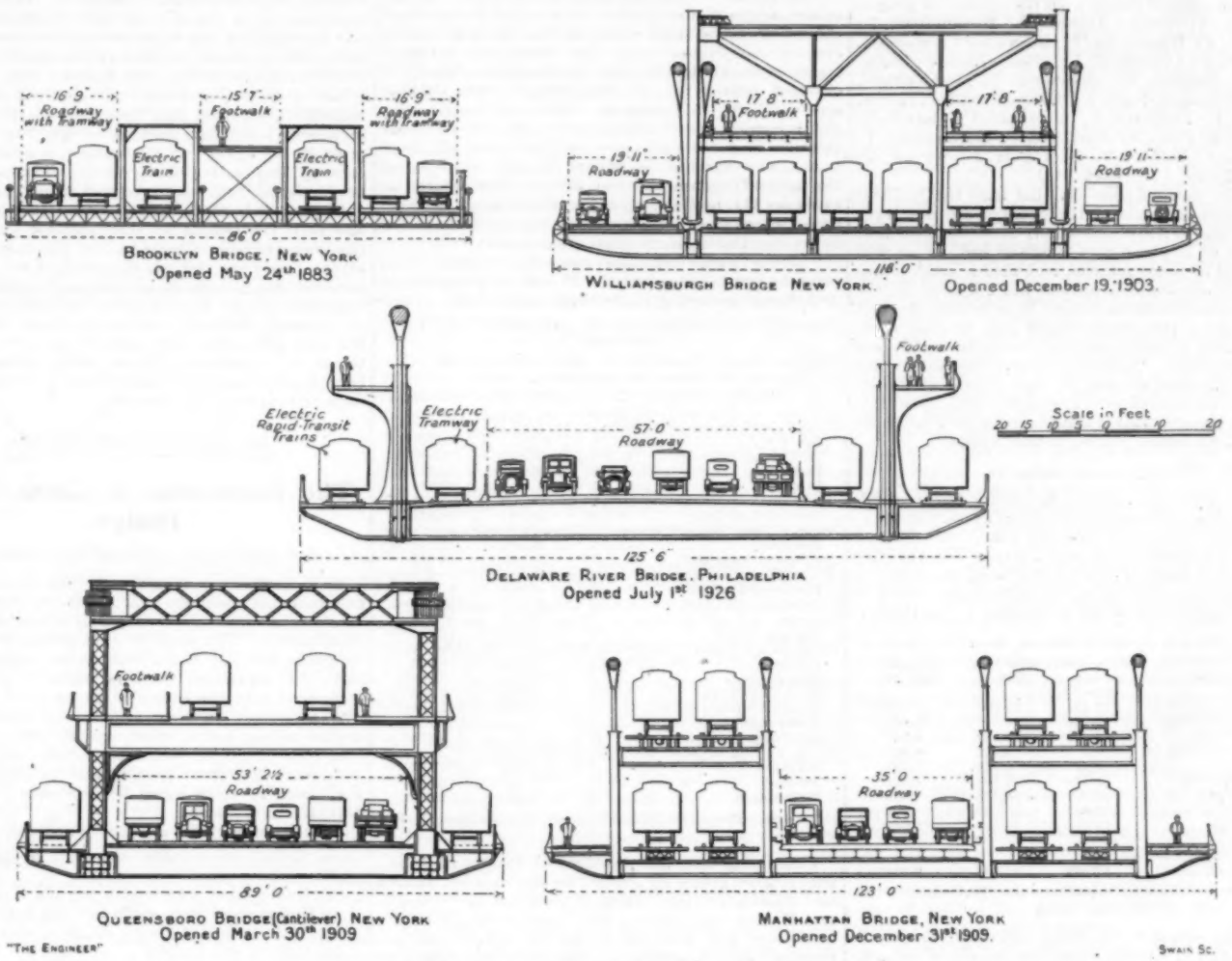


FIG. 3—COMPARATIVE CROSS SECTIONS OF VARIOUS BRIDGES

the Manhattan Bridge. In the Delaware River bridge the sag of the cables is about 200ft.

Two lines of stiffening trusses are provided, 28ft. deep and with a spacing of 89ft. between centres, to conform to that of the cables. The total width of floor is 125½ft. In the centre is a 57ft. roadway, which is flanked on each side by an electric tramway line. Beyond each tramway track and outside of the cable, is an electric rapid transit line for trains of the Philadelphia elevated and underground railways. Pedestrian traffic is accommodated by two elevated footways, 10ft. wide, level with the tops of the stiffening trusses and carried by brackets on the truss posts. The roadway has a concrete base with creosoted wood block paving. For the tramway and electric railway lines, the rails will be carried by sleepers laid across plate girder longitudinals or stringers. On the suspension spans, the maximum gradients are 1 in 33 for the roadway and 1 in 30 for the railway and tramway lines. On the approaches the maximum gradients are 1 in 28.

Two progress views are given in Figs. 4 and 5, p. 214, In Fig. 4—August, 1924—the towers are completed and temporary cables strung to carry the working bridges for the spinning and finishing of the suspension cables. At the left is the inclined steel frame carrying saddles for the cables, which pass down from these saddles into the anchorage structure. Stays and wind cables hold the working bridges in position. In Fig. 5—April, 1925—the cables and suspenders have been erected, together with a large portion of the stiffening trusses. For these trusses, the bottom booms, floor beams and truss posts are being placed the erecting travellers. Derricks on the tops of the towers are hoisting and placing the material which houses the cable saddles and forms the architectural treatment of the tower design.

As the highway travel is by far the largest item in

Alternative Designs.—After a comparison of different types of bridges for the Delaware River crossing, a bridge of the suspension type was found to be the most suitable for meeting the conditions, and also the most economical. Solid rock was found only at such great depth as to prohibit the consideration of an arch span. Alternative designs were prepared, however, for a suspension bridge and a cantilever bridge, each with a main span of 1750ft. between centres of piers. For the suspension bridge the shore spans were taken as 719½ft. For the cantilever bridge the anchor arms or shore spans were taken as 500ft., the cantilever arms to be 600ft. long and to carry a 550ft. suspended span between them, making a total length of 2750ft. The cantilever type of structure would have saved heavy expense for anchorages and for the approaches, but its advantage in superor rigidity was considered as of little account for a highway bridge.

On the other hand, the suspension type of bridge was considered to have important advantages. It would be of much less weight. It would require less time to build. It would involve less risk in construction. It would be adapted to the division of contracts among several firms. It would be cheaper in first cost. It would require less maintenance expense on account of the much smaller amount of metal exposed. And it would have a better appearance from the æsthetic point of view. The estimated weight was 47,000 tons for the cantilever and 33,000 tons for the suspension bridge, but the latter included more expensive material and costly anchorages. In first cost, the suspension bridge showed a saving of £400,000 as compared with the cantilever bridge.

An alternative design suggested was for a suspension bridge having eye-bar "chains" instead of wire argument against the use of chains was that the handling and erection of ponderous eye-bars over a navigable stream would be much more difficult and hazardous than the spinning or stringing of the wire cables. Furthermore, examinations of the wire cables of the three East River suspension bridges at New York was made at this time, and showed that all were in excellent condition after several years' service under heavy traffic conditions.

Air Pollution in English and Scotch Towns and Cities.

By JOHN B. C. KERSHAW, F.I.C.

THE Twelfth Annual Report of the Advisory Committee on Air Pollution, which has just appeared, contains, like the majority of Government publications on statistical subjects, an enormous mass of figures presented in a somewhat indigestible form, relating to the amount and character of the insoluble and soluble matters collected in the observation gauges during the twelve months ending March 31st, 1926. In the following article the figures relating to the solid impurity will be extracted from the Report and will be presented to readers of this journal in a somewhat simpler form.

All the figures used in this article are drawn from Section I. of the Report, which deals with the results obtained with the standard soot and dust gauge, while Sections II. and III. discuss the measurements made with the automatic soot and dust filter and with the jet dust counter, instruments which have been fully described in earlier articles. In the present

article limits of space will only permit the figures obtained with the standard gauge to be discussed.

The Results Obtained with the Standard Soot and Dust Gauge.

Twenty-nine public authorities are now co-operating in the measurement of the impurity of the atmosphere within their city or town areas, this number being an increase of six over the number co-operating in the previous year. The newcomers are Brighton, Cardiff, Castleford, Cheltenham, Gloucester and Leicester; but as the observation gauges at these stations had not been in use for a whole year on March 31st, 1926, no returns are included for these six towns in the present article.

The number of gauges now in use is sixty-one, an increase of twelve over the previous year's total, and about one-half of them are of the new stoneware type, described in a previous article published in 1924. The complete list of towns with the number of gauges installed is as follows:—London, 9; Birmingham, 3; Blackburn, 2; Bournville, 2; Brighton, 1; Burnley, 1; Cardiff, 1; Castleford, 1; Cheltenham, 1; Edinburgh, 3; Glasgow, 9; Gloucester, 1; Huddersfield, 2; Kingston-upon-Hull, 1; Kingston-upon-Thames, 1; Leeds, 4; Leicester, 3; Liverpool, 1; Marple, 1; Newcastle-on-Tyne, 3; Rochdale, 1; Rothamsted, 1; St. Helens, 1; Salford, 3; Southport, 2; Stirling, 1; Stoke-on-Trent, 1; Wakefield, 1.

It will be noticed from this list that the Midland and Southern districts of the country are now very well provided with observations stations, but that the North of England and Scotland are not so well represented in these returns, and that a much larger number of observation centres are required in the industrial districts of the North, in order that the soot and dust fall of the whole country may be adequately surveyed and recorded and the results from different towns compared. The new Smoke Abatement Bill which was passed during the last session of Parliament, the provisions of which come into force this year, may possibly lead to some increase in the number of public authorities joining in this work.

The London Results.

Table I. gives the London figures for the total fall of solid matter, collected in the gauge at each observation station in the two separate years 1924–25 and 1925–26, compared with the average for the five years 1918 to 1922, all the results being expressed in metric tons per hundred square kilometres, which is the form used in the tables as printed in the Report.

Table I.—*London's Soot and Dust Fall.*

Station.	Five years' average, 1918–22.	One year, 1924–25.	One year, 1925–26.
Meteorological Office	13,424	13,097	10,106
Archbishop's Park	13,763	—	14,352
Finsbury Park	14,478	11,687	8,743
Ravenscourt Park (*a*)	—	9,853	6,881
(*b*)	14,321	7,929	7,193
Southwark Park	19,178	11,364	9,221
Victoria Park	11,562	10,323	8,695
Wandsworth Common	8,882	10,950	7,050
Golden-lane	15,311	13,069	17,255
General average for all stations	13,865	11,653	9,944

Note.—(*a*) Stoneware gauge result. (*b*) Enamelled iron gauge result.

It will be seen from the above table that the cleanliness of London's atmosphere has improved remarkably since the close of the war, but the results can be much more easily grasped when expressed in the form of tons of solid matter deposited per square mile. The averages for the three periods covered by the above table then become 355 tons, 298 tons and 255 tons respectively, and indicate that in 1925–26 a total of 100 tons less of soot and filth was precipitated over each square mile of the Greater London area than in the five-year period 1918–22. London's atmosphere is now much cleaner than that of the majority of towns of the Midlands and of the manufacturing North, and if the present rate of improvement be continued for another few years London may soon expect to have an atmosphere rivalling in cleanliness that of Southport or Malvern.

The Glasgow Results.

Glasgow, like London, is well provided with soot and dust gauges, and nine of them are installed in various quarters of the city area. Table II. gives the Glasgow results for the solid matter collected at each of the observation stations during the two years 1924–25 and 1925–26, compared with the five years' average for the years 1918–22.

Table II.—*Glasgow's Soot and Dust Fall.*

Station.	Five years' average, 1918–22.	One year, 1924–25.	One year, 1925–26.
Alexandra Park	11,988	9,360	10,294
Bellahouston Park	10,904	9,765	8,609
Blythswood Square	16,399	12,937	13,257
Botanic Gardens	13,770	14,537	12,428
Queen's Park	11,079	8,209	8,493
Richmond Park	13,996	12,009	11,909
Ruchill Park	12,442	8,941	8,028
Tollcross Park	13,182	12,061	12,110
Victoria Park	11,541	12,290	11,583
General average for all stations	12,812	11,123	10,746

The above averages when converted into tons per square mile show that Glasgow's soot and dust fall, in the three periods covered by the table, has diminished from 328 tons to 285 tons and 275 tons respectively. Although this rate of improvement is not so great as in the case of London, it is sufficiently remarkable that a large busy manufacturing city like Glasgow can produce such a good result. It was pointed out in the last article, however, that both in London and Glasgow the public health authorities are showing great interest in the measurement of atmospheric pollution. The large number of soot and dust gauges installed in both cities is the outward sign of this interest; and no doubt helps to direct the attention of the average citizen to the importance of the subject and in that way assists in the improvement of the atmosphere.

Comparison of the Soot and Dust Fall of Other English and Scotch Towns and Cities.

The figures contained in this Twelfth Report of the Advisory Committee for the Air Pollution of the other towns and cities of this country which are now carrying on these observations are gathered together in Table III. and represent the total fall of solid matter for the two single years 1924–25 and 1925–26, expressed as before in metric tons per hundred square kilometres. As the five-year average is not in all cases available for all these towns, the number of gauges in use is given in the second column of the table. The figures in Columns III. and IV. represent the average in those cases, where more than one gauge is installed, and the figures for the twelve months are complete.

The towns and cities are arranged in order of their total deposit in the year 1925–26 and are grouped into five classes according to the totals registered.

Table III.—*The Soot and Dust Fall of English and Scotch Towns and Cities.*

(Total deposit of solid matter expressed in metric tons—2204 lb.—per hundred square kilometres.)

Town or city.	No. of gauges.	1924–25.	1925–26.
Group I., with deposits over 20,000 metric tons:			
Burnley	1	—	34,754
St. Helens	1	15,272	30,360
Rochdale	1	26,387	26,034
Liverpool	1	23,087	25,383
Wakefield	1	24,506	22,534
Newcastle-on-Tyne	3	30,141	21,821
Group II., with deposits between 15,000 and 20,000 metric tons:			
Blackburn	2	23,014	18,740
Kingston-upon-Hull	1	16,660	18,649
Group III., with deposits between 10,000 and 15,000 metric tons:			
Huddersfield	2	10,932	14,369
Salford	3	15,162	13,350*
Leeds	4	11,064	10,969
Glasgow	9	11,123	10,746
Group IV., with deposits between 5000 and 10,000 metric tons:			
London	9	11,563	9,966
Birmingham	3	11,004	9,368*
Bournville Works	1	7,762	8,565
Kingston-upon-Thames	1	7,938	8,100
Bournville Village	1	—	6,276
Edinburgh	3	—	6,208*
Group V., with deposits under 5000 metric tons:			
Southport	2	4,568	4,703
Marple	1	4,085	3,855
Rothamsted	1	6,969	3,690

* Note.—The results from two gauges only are used for these averages.

Examining now the positions of the towns in the above table group by group, we see that St. Helens and Blackburn have changed positions in Groups I. and II. and that Burnley now heads Group I. with a total soot and dust fall of 34,754 metric tons per hundred square kilometres, which is equivalent to 889 tons per square mile. This is, of course, an extremely bad result, and the public health authorities of Burnley and of the other five towns in this group ought certainly to make some other effort to improve the cleanliness of their atmosphere than the mere installation of one soot and dust gauge. It is possible that some improvement would be shown in these results if they followed the example of Newcastle-on-Tyne and installed two more gauges within their city areas, for then an average figure could be obtained for the soot and dust fall, which would probably show a much lower total than that for the one gauge now employed. It may be noted that the new position of Newcastle at the bottom of Group I. is due to the use of the average figure from the three gauges now installed in that city, and that had the return been based upon the total collected in the one gauge situated in the City-road district, Newcastle would have been again at the head of the group with a total solid deposit in 1925–26 of 37,043 metric tons. As stated in the previous article, one gauge is insufficient for obtaining a true record of the soot and dust fall in any town or city with an area of over one square mile. The figures given in Table IV. show what wide variations can occur in the results obtained with gauges in places where more than two are already installed.

Table IV.—*Highest and Lowest Results for Total Solids in 1925–26 for Towns with Three or More Gauges.*

Town.	Highest result.	Lowest result.
Birmingham	13,604	5,133
Glasgow	13,257	8,028
Leeds	17,207	3,344
London	17,255	6,881
Newcastle-on-Tyne	37,043	10,710

Group II. comprises only Blackburn and Kingston-upon-Hull and calls for no special comment, excepting the remark that Blackburn, which, last year, was included in Group I., has considerably improved its position and now appears in Group II. for the first time. Both Blackburn and Kingston-upon-Hull, however, might improve their positions still further and make an attempt to come below the 15,000 line, which separates Groups II. and III.

Groups III. and IV. are the most interesting, since they comprise seven of the largest and most important towns and cities of the country, and it is specially noteworthy that both London and Birmingham, which, last year, were included in Group III., have now passed over the dividing line into Group IV. and are in the same class with Bournville village and works and with Kingston-upon-Thames. Leeds and Glasgow, although they both showed some reduction of atmospheric pollution in 1925–26, are still just above this dividing line, but it is quite possible that Glasgow may pass over and join London in Group IV. when the figures for 1926–27 are available. When that occurs we shall have Glasgow, London, and Edinburgh all in the one class and only slightly removed from the cleanest class of towns in Group V. This last group comprises three towns only, viz., Southport, Marple, and Rothamsted, but these towns have changed places during the year and Southport now heads the group, while Rothamsted is at the bottom with the lowest return of 3690 metric tons per hundred square kilometres. Converted into tons per square mile, this represents a soot and dust fall of only 94½ tons and is possibly the lowest we can expect to achieve in any country area of this country until all smoke and soot are banished from our towns and cities.

Experiments made on the East Coast a few years ago with the Owens jet dust counter indicate that the finer particles of solid matter discharged into the atmosphere from the tall chimneys of our works and factories can be carried an enormous distance before being deposited. It is therefore probable that the air in country districts, especially when situated on the east and north-east sides of our manufacturing towns, is contaminated with solid matter that has been carried there by the prevailing winds from the industrial areas of the country.

The Economics of Crane Girder Design.

By EDWARD G. FIEGEHEN, M.I. Mech. E.

In an ordinary overhead travelling crane "bridge" the principal members are the two "cross-girders," surmounted by track rails upon which the hoisting crab travels. The span of such girders is often considerable, but, for cranes of moderate capacity, at any rate, the maximum bending moment is not great compared with the overall dimensions of the girder. The secondary stresses, induced by heavy concentrated rolling loads, need special consideration in this type of girder, which is further subjected to a reversing, horizontal loading due to inertia, "racking," and in some cases wind-pressure, that needs careful consideration.

Five types of girder are in common use.

(*a*) Rolled steel joists—standard or broad flange sections.
(*b*) Rolled steel joist—with top plate or channel.
(*c*) Rolled steel joist—with top and bottom plates.
(*d*) Plate-web girder with single or double webs.
(*e*) Lattice-web girders.
(*f*) Four-girder construction with horizontal bracings.

In the case of light and cheap cranes, the crab travelling wheels may run upon the upper or lower flange of the joist but more usually a rail section, or possibly a rectangular bar is provided. It is customary to neglect the sectional area of the rail in arriving at the vertical modulus of the girder section, for the reasons that it may be necessary merely to bolt the rail to its seat with rough bolts in clearance holes, so that it may easily be removed for shipment or possibly for renewal, in the case of heavy steel-works cranes. Such a connection would be unable to give the full value to the rail area as part of the flange section.

When, however, rails are adequately riveted to their seats and the rail joints are suitably designed and arranged, the area of the rail can be given its full value. In lattice-girder designs especially, the vertical rigidity of a deep rail plays a useful part in reducing the secondary bending in the bays.

A rough rule for estimating the distributive capacity of a rail, properly proportioned to the crab wheel load, assumes that it spreads this load over 20in. of the rail seat, or, say, five rivet pitches; in plate girder design the vertical shear, caused by the wheel load, would be distributed over this length and compounded with the horizontal shear at the same point.

In providing resistance to horizontal bending, a wide bridge rail may be very valuable, and should certainly be taken into account in calculating the horizontal modulus of section.

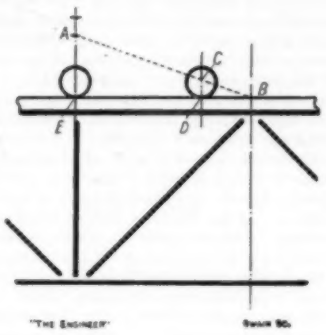
In calculating the vertical dead weight bending moment on a girder, it is sufficient to assume its weight and the proportion of platform loading that it supports as uniformly distributed. The live load on the girders will comprise the weight of the crab *plus* the maximum working load suspended *plus* vertical inertia—proportioned to the maximum hoisting speed and working conditions. In general, the

crab wheels will be equally loaded but, in some designs, they may not be. In any given case, the maximum live bending moment can be readily calculated by the usual formulæ.

In lattice-braced constructions, the secondary bending on the top flange, resulting from travelling wheel-load concentrations and the effect of these loads upon the stresses in the diagonals and verticals, will need special consideration, for the stresses are not always obvious from mere inspection or by reference to the shear diagram, as in the case of plated girders. The maximum loading will occur in bracing bars when one of the two equal wheel-loads is immediately above its upper end. The simplest way of calculating the stress is, perhaps, the useful and well-known "method of sections" which is readily applied.

After calculating the stress in bars at the ends, quarter-point and centre of the girder, suitable sections for the remainder will generally be evident, for it is undesirable to call for too great a variety of sections, for manufacturing reasons.

The usual vertical sub-struts are redundant members, so far as the main bending of the girder is concerned, but they are, in turn, subjected to a definite loading, as the crab-wheels pass over them, irrespective of their position in the span. The maximum compression, in such a strut, will occur when one of



the wheels is directly over it, as shown in the diagram, when it will support the full load of that wheel plus the proportion of the load of the other wheel intercepted at C D by the influence line A B. It is obvious that, if the crab wheel-base is equal to the unsupported bay length of the top flange E B, the vertical strut loading will be a minimum, equal to one wheel load only.

It is comparatively easy to provide the necessary material, in the flanges, to resist the vertical bending moment, but it is also necessary to consider the permissible vertical deflection of the girder, under the full load and the stability of the compression flange, as a strut under rather special conditions of loading, both primary and secondary.

The economical adjustment of depth to span is most important, for in the majority of cases, especially in cranes of small capacity, the weight of the web per foot bears a serious relation to the total weight of the girder per foot. Although some authorities limit the central deflection, under full load, to $^1/_{2000}$ of the span, this is thought to be uneconomical and rather stringent; a ratio of $^1/_{1000}$—allowing 0·48 in deflection on a 40ft. span—would appear to be more in accordance with satisfactory practice, for, even with no initial camber on the girder, the incline to be climbed by the fully loaded crab, when departing from the centre of the span, is only 1 in 500—involving a tractive effort against gravity of 4·5 lb. per ton—say, 5 per cent. of the total tractive effort—and the inclination rapidly diminishes as the crab travels to the end of the girder. With the usual stresses, the deflection ratio of $^1/_{1000}$ involves an effective girder depth of about $^1/_{12}$ span, which is found to be an economical proportion, except perhaps for small cranes, where the ratio generally approaches $^1/_{15}$.

An initial camber, equal to the estimated deflection, will, of course, insure that the rail is horizontal at full loading, but it seems certain that the problematic advantages of camber in crane girders do not justify the increased cost of production; further, it is much easier to check the correctness of level rails than the exact similarity of a pair of cambered rails, and thus, on non-cambered girders, the crab-wheels are more likely to have an even bearing at all points of travel. With regard to the horizontal loading on the girders, caused by inertia, &c., a safe rule estimates the resulting bending moment, at the centre of electric crane girders, as $^1/_{10}$ the maximum vertical bending moment at that point. For hand cranes, half this allowance would be suitable.

The top boom of a crane girder presents the unusual case of a strut, loaded with an intensity of compression that diminishes steadily from a maximum at the centre to zero at the ends and, as such, its condition of stability is possibly insoluble, by analytical methods. Modern specifications permit such a flange to be treated as a pin-ended strut, of a length equal to three-quarters of the span, and loaded with the maximum compressive stress intensity throughout.

The outstanding advantage of the four-girder construction, now common in the design of cranes for spans exceeding about 50ft., is that the compression flanges of the main girders are adequately supported, at short intervals, in resisting the horizontal bending and the main compressive forces.

Owing to the great difference in the flange areas of the top booms of the main and auxiliary girders, braced together to act as one in the horizontal plane, it is first necessary to locate the neutral axis of the combination before the respective flange stresses can be calculated, from the modulus of the cross-section, it will then be evident that the main flange takes the greater loading, being much nearer to the axis than the other; on the other hand, the secondary stress per square inch on the auxiliary girder flange will be the greater, since it is farther removed from the neutral axis and for a given deflection of the combination, will extend or compress to a greater extent. This point is quite easily overlooked, owing to the fact that, in the majority of girder problems, flanges of approximately equal area are involved, and one can, without sensible error, divide the bending moment by the total effective depth to find the flange load.

The same remarks apply, to a lesser extent, in the calculation of the flange loads in the main girder—especially when of the lattice type—under vertical loading, particularly when the rail section can be included in the top flange area, making it appreciably greater than that of the lower flange, and thus raising the neutral axis above the mid-depth line.

With regard to the torsional rigidity of box-web and lattice girders, experiments prove, rather unexpectedly, that on moderate spans and with the girder ends solidly connected to rigid end-carriages, the horizontal stiffness of the lower flange relieves the upper flange from the horizontal loading, applied by the crab wheels, &c., to an appreciable extent, certainly 25 per cent. of the whole.

In designing a range of crane girders, of a given type for various capacities and spans, it is useful to tabulate typical tension and compression flange combinations, made up of readily procurable sections, arranged in increasing capacity and numbered for reference. The weight per foot, net and gross areas, vertical and horizontal moments of inertia and moduli, are then calculated and tabulated. For a given case, the qualifications of the top and bottom flanges are easily ascertained, and from the table the nearest flange sections can be selected.

The properties of the most useful crane rails may also be tabulated, so that, when they can properly be considered as part of the top flange, the assistance afforded vertically and horizontally can be allowed, a further table of compression flanges, combined with suitable rails, can also usefully be added.

The connection of cross-girders to end-carriages does not always receive the attention it deserves.

It is not merely sufficient to connect the ends of the girders for maximum vertical shear but, owing to the horizontal loading upon the top flange of the girders, there is more or less torque to be resisted in the vertical plane at the connection. Naturally, if the girders are slung by their top flanges, the torsion around the connection is small, but if, on the other hand, they are connected by their lower flanges, the torsion may be considerable and bracing between the girders is indicated and is generally fitted for this purpose.

Although an appreciable horizontal racking action may come upon the crane "bridge" structure, under unfavourable conditions—notably when the loaded crab is at one end of the span—it is practically impossible to estimate its extent, and good practice indicates that the inherent stiffness of the connected members should be fully developed by intelligent design of the joints. The most likely distortion involves flexure at each end of both main girders, in opposite senses, and a resulting complex curvature of the end carriages. The main members of the latter must therefore be plated together for a horizontal bending strength, commensurate with the stiffness of the girder ends.

The bending value of the flanges of the connecting angles should also receive careful attention if the tensile strength of the connecting rivets and bolts is to be realised, or better, substantial horizontal gusset plates should connect the girders and end carriages, for the definite purpose of resisting the racking forces, leaving the connecting angles to their proper function as a vertical shear connection. A weak connection of the girders to the end carriages soon results in trouble from loose rivets and bolts.

In resisting racking forces, the four-girder construction shows up to advantage, but it must be remembered that the horizontal bending of the end carriage, between the main girders, still exists, and there must be sufficient stiffness to resist it satisfactorily.

The maximum bending moment, caused by two equal crab wheel-loads, occurs when either of the wheels is placed a distance—crab wheel-base ÷ 4—from the centre. The bending moment curve, for each travelling wheel-load, is a parabola. If, therefore, we construct two such bending-moment parabolas, displaced wheel-base ÷ 4 on either side of the centre of the span and combine them, we have the total bending moment curve.

The web shear will be a maximum when the fully loaded crab is at one end of its travel, and can be easily calculated; the total shear, due to live and dead loads, at the centre, will be about half this, but this shear is subject to reversal within the central "focal length."

Throughout the web, the effect of wheel concentrations must be carefully considered, especially in lattice girders, where the resulting stresses in the bars may be comparatively high. The maximum secondary bending moment, in the top flange, will generally occur when one wheel is at the centre of an unsupported length, since the wheel base of the cab will generally exceed 0·58 of that length. In calculating the resulting stress in the flange, the British Standard Specification—No. 153 for "Girder Bridges"—allows us to consider the unsupported length, as a semi-continuous beam, and the resulting bending moment as 75 per cent. of that in a freely supported beam centrally loaded. If a stiff rail has been fitted, the wheel load need not be considered as a concentrated load but as a load distributed over 20in. of rail, and the stress will be correspondingly lower.

The shape of a built girder, in elevation, deserves some consideration. For plate web construction, American practice favours the parallel type, especially for large capacities. This may tend to simplicity and economy, in manufacture, but it is heavy and notably wasteful in web material at the ends. A modified outline, much favoured, has a parallel centre portion with tapering ends. It is more economical in material and more pleasing in appearance, but care is required in the design of the riveting at the junction of parallel and tapered portions. Probably the best outline is that with a parabolic lower flange, and certainly appearance is in its favour.

The same variety of outline is to be found in lattice-braced girders and the same remarks generally apply, with the comment that parallel portions permit greater uniformity of web details.

It should be noted that the constructions involving upward-inclining bottom flanges result in greater flange stress and a smaller web stress, at the ends, and thus, with a uniform flange section, some economy in web weight is possible.

The web members of lattice girders usually consist of single channels or pairs of angles; in both cases the rivet line is necessarily offset from the gravity axis, and when strut members are designed the resulting bending moment should be taken into consideration in calculating the strength. When angle members are used in tension, the effective area must be reduced by one-half the area of the outstanding leg, to comply with the British Standard Specifications.

It is usual to provide double plate-webs for a certain length at the ends of lattice girders. This practice is satisfactory and economical, since, owing to the limited depth, lattice members of reasonable inclination must necessarily be short, whilst, owing to heavy shear, the gusset plates and riveting are out of proportion. The inner ends of the web plates act as gussets for the first lattice member, and a pleasing design results.

In dividing girders for overseas shipment, a length limit of 30ft. is usually proposed, since it enables a lower freight rate per ton to be secured. It is clearly desirable to arrange joints as far from the centre of the span as circumstances will allow, for, even in parabolic girders, the flange load will be somewhat lower and in parallel girders, appreciably so—assuming, of course, flanges of uniform section, which is usual, except in heavy girders.

The design of splices requires some care:—(1) To facilitate re-connection on site; (2) to provide some excess of shear area in rivets and bolts, the latter being, of course, turned and fitted into reamered holes.

It may be noted, in passing, that in order to secure uniformity in drilling and to prevent shop mistakes, it is good practice to drill both the rivet and bolt holes the same diameter, afterwards reamering the necessary holes for oversize bolts, for instance, a uniform hole of $^{13}/_{16}$ diameter would be drilled throughout to suit $^3/_4$ diameter rivets and reamered for $^7/_8$ diameter bolts where required.

(3) To maintain the required horizontal bending modulus of the top flange; (4) to produce compact units for shipment, without excessive projection of components, liable to damage in handling and transit.

Auxiliary lattice girders have, naturally, little bending strength, sideways, when separated from the construction for shipment; for safety they may be lashed to the side of the main-girder halves or bundled together in pairs, stiffened possibly by the platform planks and shafting.

Drawing-office Lighting.

SCHEMES for the lighting of large commercial offices are usually prepared after much thought and collaboration between architects, consulting engineers and boards of management, and, generally speaking, a pretty efficient system is installed. When it comes to the lighting of drawing-offices, however, special problems arise which are not always recognised or understood by those who are entrusted with the task of designing and installing the lighting system. By reason of the important and special nature of the work carried out in drawing-offices, illumination of a character entirely different from that employed in

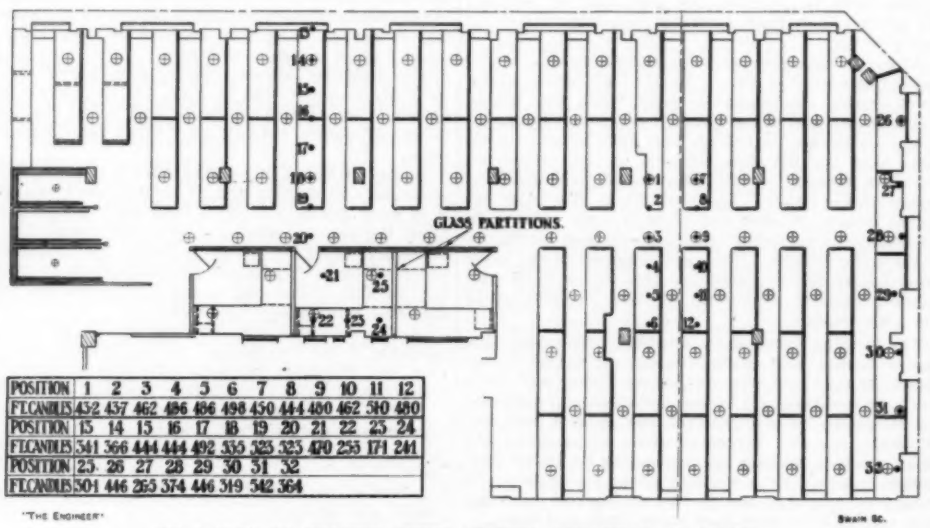
commercial offices is required. The detail of the work demands an intensity of light considerably greater than that needed in most other instances, in order that the fine pencil work which enters largely into the preparation of drawings may be accurately carried out. Apart from the difficulty of performing accurate work in a poorly lighted drawing-office and the fatigue and increased chances of error which such lighting is liable to give rise to, the tracing of fine detail work is also very difficult.

When drawing-office lighting is under consideration special conditions have to be taken into account that do not demand attention when designing lighting schemes for other offices. While it is true that in commercial offices important detail work is undertaken, the character of that work is generally such that errors are more or less self-evident. In most documents there is phraseology which aids in their study and helps to decipher them, even if the lighting is poor, whilst in accountancy rules and results assist in the direction of accuracy.

In drawing-office work, however, there is a large amount of unknown detail which has no characteristic of correctness, and good illumination is of paramount importance. The general requirements are (1) the elimination of all shadow effects from drawing boards, for no objectional shadows must be cast on these boards either by the draughtsmen or by their instruments, from front or from right or left-hand lighting; (2) the intensity of the illumination over the working plane must be sufficient for accurate detail work with immunity from eye strain; (3) adequate light diffusion must be obtained with wide and uniform distribution; (4) glare must be non-existent and work on glazed surfaces must be as easy as on non-glazed surfaces; and (5) moderate installation cost. It is also essential that the fittings should be accessible, that it should be easy to make replacements, and that there should be freedom from dust accumulation which often reduces the light.

The preparation of a suitable scheme entails the selection of lighting units and lamps of high efficiency; that is to say, high lumen output, absence of glare and wide distribution of light, and in order that no shadows may be cast over the working plane, a correct spacing-height ratio and arrangement of points are essential. The drawing-office which is shown in Fig. 1 presents an example of lighting that approximates very closely to the requirements indicated, and it affords an instance of post-war drawing-office lighting of a character which the contractors contend has never previously been attempted. The scheme has various special features, such as the provision of 191 200-watt lighting points, the use of a total of 38,000 watts in a drawing-office being something quite out of the usual. Over 100 draughtsmen are employed in these offices, which are situated on two floors, and whilst the lighting system under consideration has been in use some interesting facts have been established. The total annual charges, including the cost of current, lamps, maintenance, interest on capital outlay and depreciation, works out at less than £1 per day on a year's working, and the total annual charges expressed as a percentage of the annual wages bill is actually considerably less than 1¼ per cent., whereas a similar expression in percentage of the total annual cost of drawing-office materials, such as paper, ink, pencils, rubbers, &c., is approximately 4¾ per cent. of the annual wages bill. It will be seen therefore that an illuminating system of this nature can be carried out at a cost which is infinitesimal when compared with certain other forms of petty expenditure viewed in terms of a percentage of the annual wages charge.

FIG. 1—A WELL ILLUMINATED DRAWING-OFFICE



POSITION	1	2	3	4	5	6	7	8	9	10	11	12
FT.CANDLES	432	457	462	486	486	498	450	444	480	462	510	480
POSITION	13	14	15	16	17	18	19	20	21	22	23	24
FT.CANDLES	341	366	444	444	492	535	525	525	420	255	171	241
POSITION	25	26	27	28	29	30	31	32				
FT.CANDLES	301	446	265	374	446	319	542	364				

FIG. 2—PLAN OF DRAWING-OFFICE SHOWING DISPOSITION OF LIGHTS

The work was done by the illuminating engineering department of the General Electric Company, of Magnet House, Kingsway, W.C. 2, and Fig. 1, which is reproduced from a photograph taken by the artificial lighting, shows the type of lighting unit employed, and the method of suspension. The illustration gives some idea of the magnitude of the installation and the uniformity of the illumination which exists throughout the offices, sharpness, clarity of detail and absence of shadow being well defined throughout.

The approximate height of the ceiling from the floor level is 9ft., and the general scheme includes the small executive offices which are divided by glass partitions. On account of the low ceiling, the working plane is only 5ft. below the lamp filaments, with the fittings mounted directly on the ceiling. The provision of suitable and even illumination with the elimination of shadows on the working plane called for special arrangement and close spacing of the units, the spacing being arranged so as to provide each drawing bench with right-hand, left-hand and frontal lighting, as shown in the plan, Fig. 2. The fittings are of the well-known "Unalux" enclosed pendant type, made by the General Electric Company, with the 16in. diameter glass bowl supported by bronzed metal work, and each fitting contains a single Osram gas-filled lamp rated at 200 watts.

The plan shows the spacing of the units and gives the photometric measurements in relation to the drawing boards, which constitute the working plane 4ft. from the floor level. As indicated by the numbers on the plan, measurements of the illumination were made at thirty-two points, and the intensity in foot-candles of the illumination at the various points is given in the table at the bottom left-hand corner, the average intensity approximating 46 foot-candles. The scheme was designed to provide an ultimate average of 30 foot-candles on the working plane, and in order to arrive at that figure suitable allowances were made for the inevitable falling off in the lumen output of the lamps during their normal average life. Darkening of walls and ceilings through ageing and diminished light arising from dust accumulation on fittings between the times of cleaning were also taken into consideration, and the sum of these allowances was estimated to be just over 25 per cent., thus reducing the initial intensity obtainable from new lamps, new fittings and clean walls and ceilings to a value of approximately 33 foot-candles. Even when taking into account such an obviously bad working position as No. 13 on the plan, the lighting is wonderfully uniform; as it is in those positions situated under the sloping roof and numbered 26 to 32. Notwithstanding the unfavourable positions of these points, the inequality ratio in the main offices, *i.e.*, the maximum divided by the minimum illumination, is only 2 : 1; whilst in those positions of the offices in which the bulk of the work is performed the ratio is 1·2 : 1.

Tests carried on on a number of the drawing boards with the object of determining their freedom from shadow effects resulted in it being impossible to detect or even to create anything in the nature of objectional shadows. The tests proved that the finest lines could be drawn with perfect ease and precision from either the right or the left-hand side of the set square—a condition that prevails in few offices of this character. The installation should stimulate an effort to secure better lighting in drawing-offices associated with various industries, especially as it demonstrates in a forcible manner the advantages that can be derived from efficient illumination at low cost. The wiring installation was carried out by Tyler and Freeman, of Chancery-lane, W.C. 2.

Institution of Mechanical Engineers.

THE eightieth annual general meeting of the Institution of Mechanical Engineers was held in London on Friday evening of last week, February 18th, under the chairmanship of the retiring president, Mr. William Reavell. The business of the meeting began with the presentation of the Council's annual report, of which we give a summary.

ANNUAL REPORT OF THE COUNCIL.

During the year there was a net addition of 312 to the membership roll, the total of which on December 31st, 1926, stood at 10,117. On the financial side the report records a revenue of £33,862 and an expenditure of £33,419, including £1000 transferred to the Reserve Fund. Of the candidates taking the Institution examination 95 passed the studentship section and 186 the associate membership section or parts of it. Under the joint national scheme 1647 candidates offered themselves. These examinations resulted in the award of 578 ordinary and 242 higher certificates and 35 ordinary and 27 higher diplomas. Over a hundred schools and institutions now conduct approved courses under the national scheme. Dealing with the work of the research committees, the report records that investigations for the Alloys of Iron Research Committee, a joint committee of several learned societies headed by the Royal Society, were continued at the National Physical Laboratory and consisted principally of further study of the alloys of iron and chromium, manganese and phosphorus. The Cutting Tools Research Committee presented a report by Mr. E. G. Herbert on "Cutting Temperatures and their Effect on Tools and Work Materials." For the Hardness Tests Research Committee work was continued at the National Physical Laboratory in completion of Mr. Hankins' study of diamond cone indentation hardness tests. At Manchester research

work was undertaken for the Steam Nozzles Research Committee. This work comprised tests on a 20 deg. thin plate impulse nozzle and surface finish tests on an 1¾in. diameter single straight elementary nozzle. At Woolwich Dr. Scoble continued his tests on 1in. ropes for the Wire Ropes Research Committee. A new machine to test simultaneously two 2in. circumference ropes is now being constructed, and if it is found satisfactory it will be arranged to test four specimens in order to reduce the total time for the trials. The sum expended on research work during the year was £1342. A sum of £856 is entered under the heading of Research Grants Suspense Account.

The report, after its adoption had been moved by Mr. Reavell and seconded by Sir Henry Fowler, was subjected to some friendly criticism by Mr. E. C. Marks. Mr. Marks congratulated the Council on the fact that the membership now exceeded the 10,000 mark, on the transfer of £1000 to the General Reserve Fund, on the small cost of the local branches, £1144, and on the reduction that had been effected in the printing expenses. He could not, however, offer his congratulations on the large sum, £11,391, involved in salaries, pensions and superannuation expenses for the headquarters staff. That figure was equivalent to 23s. per head of the enrolled membership, or, in other words, for every pound received from the members by way of subscriptions 8s. was expended on the maintenance of the headquarters staff. Comparing last year's balance sheet with that for 1908, he found that in the pre-war year, when the membership roll was smaller and the subscription rates lower, the subscription income was less than half what it was last year and the expenditure on the headquarters staff was only one-quarter. He thought that in this matter of staff expenses the Institution was progressing a little too rapidly. In the accounts for the Staff Pensions Fund he noticed an item of £8255 entered as "Arrears of Staff Superannuation Premiums." To meet this charge stocks had been sold to an equivalent amount. Who was in arrears and what was the explanation behind the transaction? He felt, as an old member, that unless the war-time increases in the annual subscription rates were reviewed there would be some difficulty in maintaining the present number of members on the roll. A big membership should mean reduced subscriptions.

Sir John Dewrance thanked Mr. Marks for his kindly criticism. The item of £8255 in the staff pensions sum represented the value of premiums that had accrued as a result of the transference of the Fund from the Institution's own management to that of the Norwich Union Life Insurance Society. That transference would result in economy to the Institution and increased satisfaction to those benefiting from the fund. The questions of the cost of subscriptions and the extra expenditure involved in running the Institution had been most carefully considered by the Finance Committee, and largely as a result of Mr. Pendred's work considerable economy had been effected in the printing account. It was to be noted, however, that much more was expected of the Institution to-day than in 1908. It was impossible to return to the conditions of 1908. There was no evidence to the effect that the members, if they had the choice, would prefer smaller subscriptions and reduced service. The membership curves exhibited no reason to fear a falling off in the new membership. Mr. Bath Spencer supported Sir John Dewrance, and was warmly applauded by the meeting for his assertion that not only was more expected of the staff than in former years, but that in his experience more was obtained.

Mr. Reavell, dealing with this matter of increased service given by the Institution, instanced the National Certificates Scheme and the work of the Marine Oil Engine Trials Committee, both of which called for increased staff work. The past year, he continued, had seen the definite launching of a complete and satisfactory scheme of staff superannuation. That scheme was founded on a contributory basis and would promote economy and the happiness of the staff.

The report was carried unanimously. The presentation of prizes followed, and thereafter Mr. Reavell inducted Sir Henry Fowler as president for the ensuing year.

High-pressure Steam Plants.

An hour after the opening of the proceedings the meeting settled down to resume the discussion of Professors Mellanby and Kerr's paper entitled "The Use and Economy of High-pressure Steam Plants." This paper was reprinted in full in our issues of January 28th, February 4th, and February 11th. In addition, there was discussed Mr. H. L. Guy's paper, "The Economic Value of Increased Steam Pressure," which was read before the North-Western Branch on November 4th, 1926, and which we printed in our issues of November 12th and 19th.

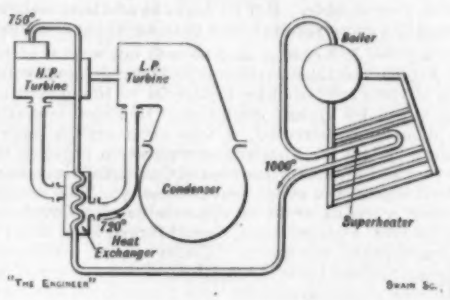
Mr. Wm. H. Patchell, opening the joint discussion, remarked that the efficiencies obtained by the use of high steam pressures and temperatures could be nicely calculated on the drawing board, but they did not always agree with the actual efficiency results obtained in practice. It was not always the most expensive plant which gave the best results. He was glad that Professors Mellanby and Kerr dealt with Professor Lea's investigation of creep in metals, an important paper on which had been read some time ago before the Institution. He doubted whether the tube temperatures quoted by the joint authors existed in reality, and he would be glad to learn on what authority the figures given were based. Mr. Guy's paper embodied the experience of a practical turbine man and his method of approaching the subject, namely, a study of the increased cost required to obtain increased efficiency, was the right way to look at the matter. Incidentally, Mr. Guy's figure for the price of coal, 15s. per ton, made London engineers envious. He hoped Mr. Guy would give some particulars concerning the performance of the King George V., for reports that had been published instituting a comparison between that vessel and the Barton power station seemed to have gone astray by comparing steam consumption per shaft horse-power with steam consumption per kilowatt. Mr. Patchell concluded by giving the latest available figures for the thermal efficiencies of several American high-pressure steam plants.

Mr. A. Spyer maintained that high-pressure, high-temperature steam plants should and would, with the variety of fuel available, give greater economy than oil engines, all financial and commercial considerations being taken into account. Such steam plants could develop a kilowatt-hour for 13,000–14,000 B.Th.U. or 1 shaft horse-power hour for 10,000 B.Th.U. That performance enabled a highly satisfactory competition to be instituted with Diesel engines, the relative costs of the fuel being taken into consideration. He estimated the relative fuel costs at 123 for the coal-fired steam plant and 189 for the Diesel engine plant. In the present state of metallurgy, he continued, any departure from standard materials had the grave disadvantage of being attended by a greatly increased cost, the price sometimes being multiplied ninefold. Up to temperatures of 750–800 deg. Fah. ordinary steel would answer the needs satisfactory for the time being. In the Loeffler installation in Germany ordinary steel was used for the superheater tubes carrying a steam temperature of 1000 deg. Fah. It was important, however, to notice that at such high temperatures design should be based on the elastic limit of materials and not on their ultimate strength. The purity of the feed water was a very vital question in high pressure, high temperature steam plants, and in that respect it was worthy of note that the suppression of condenser leakage as well as the durability of the tubes had been greatly promoted by the adoption of copper-nickel tubes. The capacity of the heating surfaces for absorbing radiant heat was an important factor in the performance of high-pressure, high-temperature plants, but it should be remembered that the life of the surfaces was greatly affected by the rate of the transmission. To increase that rate to a large extent was, in his view, a mistake. Some years ago, in an attempt to discover the highest rate of transmission, he had reached a figure of 140,000 B.Th.U. per square foot per hour, but such a rate could be maintained only for a few moments. In practice 12,000–14,000 B.Th.U. represented the average transmission rate in very high-class boilers maintained under such conditions as exist in the Navy. At these high rates the gases must leave the heating surfaces at a very high temperature, and consequently for economy additional apparatus would have to be fitted to absorb the waste heat.

Mr. B. Pochobradsky remarked that Mr. Guy's view would in general be taken by those responsible for the generation of power in preference to the standpoint covered by Professors Mellanby and Kerr's paper. The inefficiency at high pressures of which mention was made in both papers was, in his opinion, exaggerated, and he believed that under both arguments still higher pressures should be striven for. Mr. Guy's 12 per cent. and 18 per cent. capital charges included 5 per cent. and 6 per cent. respectively for interest. Interest in the case of a power-house was, he, Mr. Pochobradsky, argued, a product. It was a plus quantity which the plant produced. It was a credit not a debit. In addition to the kilowatts generated the new capital created should be taken into account. If that view were taken the maximum pressure which would be commercially profitable was still further increased. Pressures of 1000 lb. to 1200 lb. would not immediately become attractive, but he thought that Mr. Guy's suggested economical limit of 350 lb. was too low. Something between that figure and the joint authors' 1000 lb. would be about right for the conditions of to-day. It was wrong to approach the subject by studying what the turbine of yesterday could be made to do under higher pressures and temperatures. The high-pressure, high-temperature problem should be studied from a fresh start from the outset. The engineer, for example, had to find a means of using increased pressures with no more leakage losses than occurred in a low-pressure plant. In conclusion, he suggested that economical and satisfactory results might be obtained by using the high-pressure section of a power plant for normal running and employing steam accumulators and the low-pressure section for the peak loads.

Major S. J. Thompson emphasised the necessity for accompanying thermal efficiency in power plants with what the Americans called "dollar efficiency." He had recently inspected the Crawford-avenue and Philo stations in the United States and found the 600 lb. boilers running as satisfactorily as low-pressure boilers in this country. At the Weymouth station boilers generating steam at 1200 lb. were now in service. Temperatures were even more important from the point of view of design than pressure, and he thought it was only right and just to accord every credit and recognition to the Babcock and Wilcox Company for the work it had done in developing the high-pressure, high-temperature boiler. Professors Mellanby and Kerr, he continued, seemed to suggest that politics entered into the matter, but he hoped that the members of the audience would, as engineers, see to it that it did not. Whether there was to be a little more or less coal 150 years hence was not such an important factor as the obtaining of increased economy here and now. Dealing with the question of materials, he said that ordinary steel, not chrome steel, was being used in the Weymouth boilers, and that the results so far obtained were satisfactory.

Mr. R. H. Collingham gave particulars of a system whereby high pressures might be used in turbines without involving the use of high temperatures. A diagram which he sketched on the blackboard is



reproduced herewith. The steam superheated to 1000 deg. Fah. was, Mr. Collingham explained, passed through a heat exchanger on its way to the high-pressure turbine and entered that turbine at 750 deg. Between the high-pressure and low-pressure turbines it was reheated in the heat exchanger and entered the low-pressure turbine at 720 deg. Compared with 1000 deg. steam expanded in the ordinary manner, this cycle, according to figures which Mr. Collingham gave the meeting, showed a theoretical increase of efficiency of 2 to 3 per cent.

Professor Kerr, replying to the discussion, said that the debates on the paper in the different centres reminded him of the definition of Scotland as 30,000 square miles of land, mostly on end. The different discussions had mostly been inverted so much so that they really answered one another, and therefore left little for him to deal with by way of reply. The paper had been made intentionally provocative, but several points had been attacked which they had thought would not have been, while others, which were really windmills that would collapse on assault, had been missed. Mr. Patchell's American figures, he remarked, seemed to agree closely with those plotted in the paper. The heat transmission coefficients, concerning the origin of which Mr. Patchell was curious, had been obtained from American data. He agreed with Mr. Spyer's remarks regarding the elastic limit and the ultimate strength, and would analyse Mr. Collingham's cycle in the final reply. Concluding, he expressed particular thanks to Mr. R. H. Parsons for the information he had given in the earlier discussion regarding the Langerbrugge power station.

Mr. Guy, replying to Mr. Patchell, explained that the figure for the price of coal, 15s. per ton, represented the average price paid during the coal strike by several power-houses with which he had communicated. Regarding the King George V. and Barton, he stated that the Barton efficiency figure during a period of one month was really about 25 per cent. higher than that of the Clyde steamer. The comparison, however, was fair neither to the station nor the steamer. Mr. Pochobradsky's suggestion regarding the correct manner of looking at interest was, he said, revolutionary to a degree that would receive no backing even in Soviet Russia.

Professors Mellanby and Kerr's paper was presented at a joint meeting of the North-Western Branch and the Liverpool Engineering Society at Liverpool on Feb. 11th, and again at Manchester before the Branch.

We extract some points of interest from the discussions on these occasions.

At the Liverpool meeting Mr. Lloyd Barnes took the chair, and the discussion was opened by Mr. Willet Bruce.

He said that when they really looked the question of higher pressures squarely in the face for marine practice, he did not think they had very much to worry about. After all, the adoption of higher pressure steam for turbines was only, to speak briefly, the application of higher pressure to one individual unit, namely, the high-pressure turbine. Provided they could get material to stand the stress under the high temperatures to which it was subjected, marine engine builders would be perfectly confident of success. But he went further than that. When they had

secured the thermal efficiency and had got the material right, there was one important feature, and it was this:—He did not think he was wrong in saying that unless they could get a highly successful, tight and efficient condenser, all the high-pressures and water-tube boilers would be an absolute failure. That most important subject marine engineers had been studying for the last five years in particular, and it still remained a source of great anxiety. Some most eminent engineers, including Sir Charles Parsons, were making most elaborate experiments with regard to getting a satisfactory condenser which would stand up to the work. There was another important thing which they were up against every day in ordinary practice. Sometimes a man would jump overboard, and the result was a cry of "Man overboard." The order then was "Full speed astern." The pressure rose; they blew off. What was going to be the result with the pressure blowing off at 500 lb.? There was not a man on board who would hear the command to lower a boat. Moreover, when the safety valves relieved themselves, there was not one out of the lot that would be tight again. Even with 250 lb. pressure, with which they were working every day, they met with that trouble. But he ought to add that stainless steel had given results better than anything else tried.

Mr. W. J. Kearton said he was not sure that the "Atmos" and Benson boilers had been designed solely to obviate any troubles incidental to the generation of steam by violent ebullition. In steam boilers as ordinarily constructed, it was necessary to have a more or less level surface of separation between the water and the steam, the area of this surface increasing with increase of evaporative capacity. This necessitated a steam drum of appreciable size, involving, with very high pressure, a solid forged steel drum of considerable thickness. Under these conditions, boiler-making became something akin to gun-making. He was quite in sympathy with the authors' statement that the "Atmos" and Benson boilers had hardly yet affected boiler methods, and, further, he did not think that the rotating tube type ever would become a boiler type *per se*, but if the rotating tube principle ever were adopted, he thought it might serve as the high-pressure section of a two-pressure boiler, the rotating tubes being placed in a horizontal row just under the ordinary water-tubes. The fundamental drawback to the use of high pressure or high temperature steam as a means of increasing the thermal efficiency of steam plants was the small thermal capacity at the higher temperatures. In other words, the gain of mean effective temperature, as Mr. G. M. Clark had put it, was only slight for an appreciable increase in the total temperature. The process of re-superheating was really an attempt to add more heat at the higher temperatures and so combat this shortcoming of the physical properties. It also had a beneficial effect on turbine performance for other reasons. But when an attempt was made to combine the re-heating process with extensive regenerative feed heating, difficulties which had not apparently been apprehended by the authors seemed to appear. If regenerative feed heating was to be carried out most effectively, then the temperature of the bled steam should not exceed that of the water it was to heat by more than the few degrees of temperature necessary to produce the transmission of heat. Assuming in a specific case, which the speaker illustrated by a diagram, no drop of temperature, then the pressure of the steam bled from the turbine to heat the feed up to saturation temperature was given by the point of intersection of the expansion line with the 598·2 deg. Fah. isothermal. But the pressure of the steam was then only about 48 lb. per square inch absolute. Clearly such steam could neither cool nor condense, for its saturation temperature was only 278 deg. Fah., *i.e.*, 320 deg. Fah. below that of the water it was to heat. The authors had, however, shown by means of Fig. 8 of the paper that steam was tapped for feed-heating purposes at some point prior to entering the first of the re-heaters. Assuming for the sake of illustration that that might be done at a pressure of 750 lb. per square inch, the condition of the steam was such that its temperature was about 740 deg. Fah. If such steam were admitted to a surface heater and cooled down to the final temperature of the feed water, viz., 598·2 deg. Fah.—assuming that the entire feed heating was done in that manner—then the heat liberated per pound of steam would be about 87 B.Th.U. Assuming a liquid heat step of 50 B.Th.U., then per pound of feed, 57·5 per cent. of the steam would require to be cooled in the heater down to about 600 deg. Fah. But obviously such steam could not be condensed, and there could be no bleeding in the true sense of the word. One means of overcoming the difficulty would be to extract a small quantity of steam and compress it up to a pressure a little higher than the vapour pressure corresponding to the final temperature of the feed water in the particular heater considered. Three years ago the speaker had had the privilege of reading before the Institution a paper dealing with the possibility of using two working fluids, viz., mercury and steam. He still thought that was an attractive alternative to the high-pressure steam plant. Mr. Kearton said he would not weary the members with figures, but it could be shown that the thermal efficiency of the boiler-turbine-condenser system was no less than 41·5 per cent.

Professor Watkinson said he did not see any reason why the air should not be raised to a temperature of 1000 deg. Fah. or even higher. One advantage due to that, an advantage which he had pointed out more than twenty years ago, would be that the boiler could be cut down in size, weight and cost. He was very glad that Professor Mellanby had referred to the results obtained on the trials of the King George V. Professor Watkinson said he gathered that the efficiency had worked out at 17 or 18 per cent. or thereabouts. If that were so, he would say, "Scrap this complex steam plant entirely, and go in for Diesel engines." They would give twice that efficiency. If modern steam plant was considered from beginning to end, its enormous complexity as compared with an internal combustion engine would be realised. It was stated that the internal combustion engine was more costly. That was a matter which would be ended in the near future. The more that were constructed the less would be the cost of construction. The authors said that the aim should be to get the highest possible thermal efficiency irrespective of the commercial aspect. Professor Watkinson did not think that anyone who had to deal with the matter from the commercial point of view would agree with that. What they had to do was to get a compromise so that the net result would be a maximum, and there was undoubtedly a limit set by the financial side of the question.

At the Manchester meeting Mr. Harold Massey was in the chair.

In the discussion Mr. R. W. Bailey (Research Department, Metropolitan-Vickers Electrical Company, Ltd.) said the authors were quite right in devoting so much attention to the physical properties of metals at high temperature, seeing that the performance at high temperature depended on what they could get from the metals, but he thought that their symbolic deductions were a little premature, in view of the present state of knowledge on the subject of creep. It was stated in the paper that there was a limiting creep stress. People who were investigating the subject of creep were more and more coming to the conclusion that, as their apparatus became more sensitive and the methods of test more accurate, so the limiting creep stress receded from values which had been taken to be acceptable. Where limiting creep stress had been found by investigators, they had generally adopted the same method in plotting out their results, and he thought they had been misled in getting a limiting creep stress in that case. Mr. Bailey then developed his argument with the help of slides. It was clear, he thought, that engineers really needed more data on that subject. There was a good deal of work being done under the Department of Scientific and Industrial Research, the B.E.I.R.A., &c., and it was hoped that it would soon be available so that engineers might get guidance on the subject.

Mr. A. Stubbs said he had been interested in the paper, and more so because of Mr. Guy's paper, which had been recently read before that Centre of the Institution. One would conclude from Mr. Guy's paper that the economic position did not call for steam pressures exceeding 350 lb. per square inch gauge, with the possible exception in one or two cases where special circumstances might be shown to exist. He was quite convinced that, with the present state of the art, there was little or nothing to be gained in £ s. d. by adopting higher steam pressures; but Mr. Guy had shown that the economic curves when plotted with pressure as a variable were flat. It would be reasonable, therefore, to assume that the engineers who were working on higher steam pressures were not paying an exceptionally high price for their experience. He also thought that future developments in the art of power generation would remove the present economic boundary, so that those who had gained experience with the new conditions would be in an advantageous position. He had had occasion to consider a cycle of operations in which it was intended primarily to improve the space factor of power station plant, and with it the capital cost, whilst still maintaining the efficiency. Such a cycle might consist of, say, an oil-fired furnace operating under a pressure of 4-5 atmospheres. The steam generated would be used with the standard turbo-alternator set, the turbine being bled for feed heating. Preheated air would be supplied to the furnace at a high temperature, and the flue gases after passing the air preheaters would pass through a gas turbine entering the same at a suitable temperature and exhausting to a small economiser for some feed water heating. The gas turbine would drive a turbo-compressor, which would supply the air to the preheater. The system was simple and the ordinary forced and induced draught fans were replaced by the compressor and gas turbine respectively. The losses due to the inefficiency of the compressor and the turbine appeared as heat, and were transmitted to the steam, so that they were not lost to the system. They had, however, the effect of making it necessary to introduce a small water economiser, which meant that the cycle was not quite so good as it would otherwise be, since the feed water heating which was done by that economiser might be the better performed by steam bled from the main turbine.

Mr. J. M. Newton (Metropolitan-Vickers Electrical Company, Ltd.) said that he would like to draw attention to what seemed to him to be a challenging statement and one of fundamental importance, namely, that ". . . the ultimate aim must be the achievement of the highest thermal economy open to engineering skill and consistent with plant reliability, and limited by these only." He considered that that was not the real aim of an engineer. His duty was to produce power at the lowest overall cost. It might be that those two aims closely coincided, in which case no difficulty arose, but it was conceivable that they might lead to widely divergent results, and while he agreed that it was the duty of the engineer to save fuel, it was equally his duty to save other national assets, of which one was capital. It would lead one very far to discuss that point of view. If an engineer ignored the cost of obtaining a thing, he would be very lucky to get a chance to carry out his schemes. On the question of increase in pressures, he felt that caution should be observed in making an increase, except for a case which was experimental. In this country, for instance, they had the fact that the engineers had put up a large power station working at 450 lb. pressure preheating, and they had since put up another very large station at a lower pressure and, he thought, without preheating. In America there was a fair number of large plants working at about 600 lb. steam pressure. The information he had led him to believe that they were working and running day in and day out satisfactorily. But he also believed that some of those large stations had not quite realised the expectations of their designers. He thought it would be well to await further information before forward steps were made in the direction of increasing pressures in this country.

On Thursday evening, February 17th, a conversazione was held by the Institution in the Natural History Museum, South Kensington, to celebrate the enrolment of the 10,000th member. The President, Mr. William Reavell, and Mrs. Reavell received the guests. The attendance was very large, and it was generally agreed that the brilliant entertainment made a fitting conclusion to Mr. Reavell's most successful year of office.

ELECTRICAL INSTRUMENTS.

IT is somewhat curious that during the past thirty-five years only two papers on electrical measuring instruments have been read before the Institution of Electrical Engineers. A short time ago, however, Lieut.-Colonel K. Edgcumbe and Mr. F. E. J. Ockenden presented a paper on "Some Recent Advances in Alternating-current Measuring Instruments," in which the more important developments of the last few years are dealt with. As the subject is a very broad one, the authors confined themselves to indicating and recording instruments, as distinguished from integrating meters. The paper shows that by a process of elimination the operating principles employed are gradually becoming less in number. The use of the hot-wire principle, for example, is now almost confined to radio frequency measurements, and for the measurement of current and voltage at ordinary frequencies, the electro-dynamic and induction principles will probably give place to the moving iron principle, a useful feature of the moving iron type of meter being the wide latitude that is possible as regards the opening out or closing in of the scale divisions to suit the purpose for which it is required.

The moving iron instrument is investigated in the paper from what is thought to be a new standpoint and a form of precision moving iron ammeter and voltmeter with an accuracy of about 0·1 per cent., and suitable for use indiscriminately with alternating and direct current is described. The use of series condensers for the extension of the range of electrostatic voltmeters for extra-high voltage measurements is dealt with, as are also the conditions necessary for the attainment of reasonable accuracy. The use and limitations of thermo-expansion (hot wire) ammeters for radio current measurements is considered, and a current transformer suitable for such measurements up to 1000 ampères is described.

It is shown that special considerations are involved in the measurement of rectified current. Some recent developments in the field of graphic instruments are dealt with, particularly as regards the relay pattern which has proved to be valuable for traction and many other special purposes. A method of ensuring constant frequency on a supply system is considered, together with the advantages which accrue as regards ease of interlinking and the possibility of driving recorders, time switches, &c., by means of a simple and compact self-starting synchronous motor. The design of current transformers is discussed and consideration is paid to the use of some new materials for the core.

The design of a bar or bushing transformer for low currents and a precision type of current transformer is then described, the latter being suitable for use with substandard measuring instruments and having a ratio error of less than 0·1 per cent. and a phase displacement of less than 5 minutes. The desirability of connecting a protective resistance in series with a voltage transformer is emphasised, and it is shown that, providing that it is properly designed such a resistance need not adversely affect the characteristics of the transformer. The capacity of meters, shunts, current transformers, &c., to withstand heavy short-circuit currents is considered and safe limiting values are deduced.

Werkspoor Indicator Gear.

IN the discussion on the Fifth Report of the Marine Oil Engines Trials Committee—see THE ENGINEER of December 17th, 1926—dealing with the trials of the main engines of the motor vessel Cape York, criticism was made on the low mechanical efficiency and the unsatisfactory values of the I.H.P. measured during the trials. In reply to the criticism which was made, the following statement has been prepared by R. and W. Hawthorn, Leslie and Co., Ltd., St. Peter's Works, Newcastle-upon-Tyne, conjointly with the Werkspoor Engine Works, of Amsterdam. It will duly be printed in the "Proceedings" of the Institution of Mechanical Engineers, and we are indebted to the secretary of that Institution for permission, on account of its technical interest, to allow this statement to appear in the columns of THE ENGINEER before the "Proceedings" are published.

It was already pointed out in the course of the discussion that the discrepancies must be attributed to errors in the determination of the I.H.P., and that the mechanical

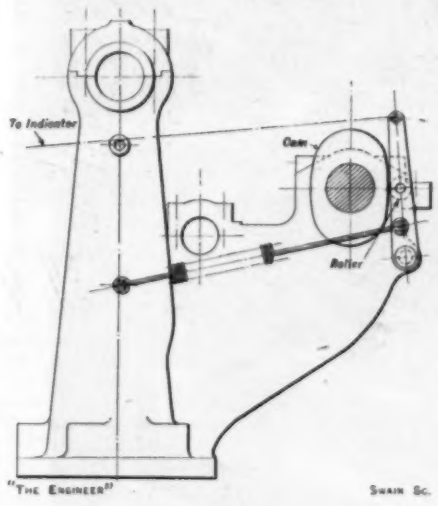


FIG. 1

efficiency consequently appears lower than it actually is.

The figures for the fuel consumption per B.H.P. per hour quoted for the shore tests are, if anything, on the high side, whereas those per I.H.P. hour are, on the contrary, far too low.

The accurate determination of the I.H.P. entails considerable trouble; the M.I.P. usually being on the high side for the following reasons:—

(1) The length of the gas passage from the cylinder to the indicator causes the pressure on the indicator piston to lag behind the pressure in the cylinder and renders the card larger than it should be. Narrow bore or obstructions in the indicator cock have a similar effect.

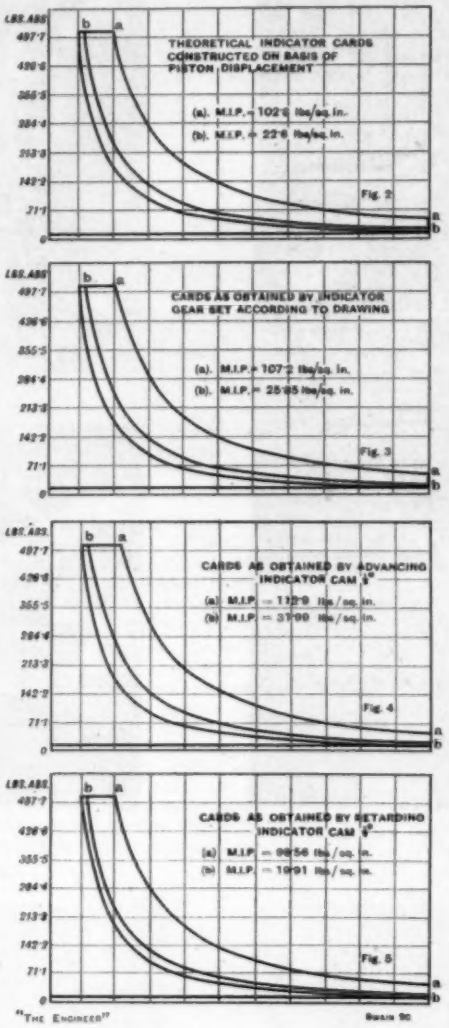
(2) Any lag in the recording mechanism of the indicator results in a larger area of the cards. Most indicators will be found to develop this weakness after a short time.

(3) the friction of the indicator pencil on the paper has a similar effect on the card.

The indicator drive is generally responsible for a portion of the error. The problem of designing an indicator gear which will give accurate results is an intricate one, and the best method of obtaining a correct reproduction of the piston displacement is to work the indicator drum from the crosshead of the engine.

For practical reasons the drive for the drum is generally taken from the cam shaft. This, however, gives rise to new trouble. Owing to distortion of the cam shaft and inevitable play in the cam shaft drive, the position of the indicator drum differs from the position of the piston to which it should correspond.

Another point, however, is more important. The drive, which now has been employed in the Werkspoor design for some years and which has given the best service, is represented in Fig. 1. All others, including those fitted with toothed gears worked from the crank shaft and being a copy of the main crank drive on a small scale, have failed by excessive wear in service. The design represented in Fig. 1, consisting of a lever worked by a roller running on the surface of an accurately profiled cam secured to the cam shaft, is practically free from wear and tear. The manufacture of the gear calls for considerable precision, but not for more than would be required by any other reliable gear. The setting has to be effected with care, as may be judged from the above diagrams, Figs. 2–5.



FIGS. 2 TO 5

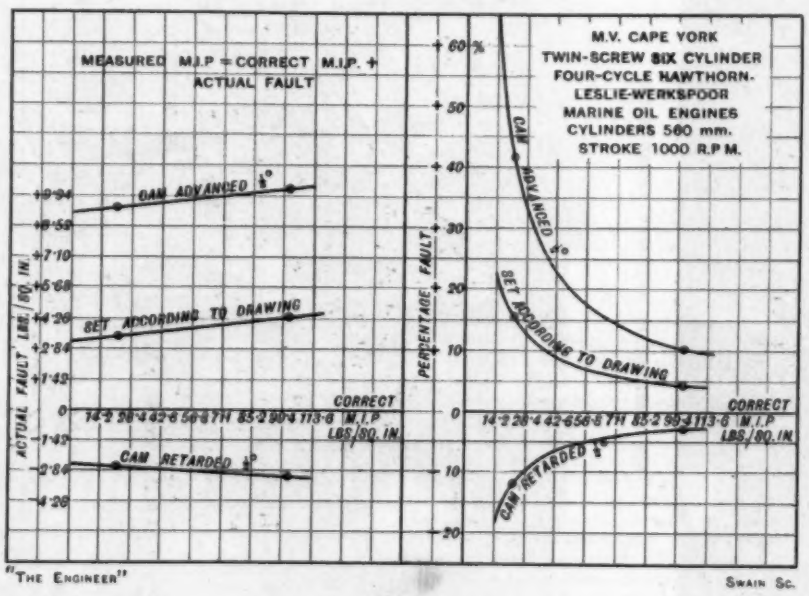


FIG. 6

Assuming a certain law for the shape of the expansion and compression curves, two constant pressure cycle cards have been drawn in Fig. 2 on the basis of actual piston displacement and the mean indicated pressures determined. These are approximately in accordance with maximum overload and engine running light.

In Fig. 3 the position of the indicator drum, as determined from the actual design of the drive, is substituted for the position of the piston. The areas of the cards are found to be larger than they actually should be; these errors should be compensated by adjustment.

In Figs. 4 and 5 the effect of advancing and retarding the cam half a degree from its original position is demonstrated. The errors found under the different circumstances are shown in Fig. 6. This demonstrates that at normal full load (N.I.P. = 6·25 atm.) a mistake of half a degree in the setting of the cam amounts to an error of 10·1 lb. per square inch, or 11¼ per cent. in the I.H.P. From this it may be inferred that in order to obtain the I.H.P. at full load accurately within 1 per cent., the cam has to be set accurately within approximately one-tenth of a degree. It is obviously impossible to obtain this accuracy when erecting the engine, and the settings have therefore to be checked before running final tests. To make this possible the indicator cams are not keyed to the shaft, but fixed by means of set screws, so that their exact position can be more easily obtained.

Similar conditions exist when the indicator drive is arranged for by an excentric. In this case the excentric has to be very accurately keyed if considerable discrepancies in the tests results are to be avoided.

The Mining Industry of New South Wales.

THE following particulars have been taken from a statement furnished by the Under-Secretary for Mines—Mr. F. S. Mance—to the Minister—the Hon. J. M. Baddeley—with regard to the mining industry in New South Wales during 1926, which has been sent to the Department of Overseas Trade by the British Senior Trade Commissioner in Australia.

It is anticipated that the final returns for 1926 should make a very satisfactory showing, although it is thought that the value of the production will be slightly less than that of the previous year. The output for 1925 was valued at £19,800,000 and constituted a record for the State, being over a million pounds in value in excess of the best previous year. Owing to interruption of operations for a time on several of thefields, that record cannot be expected to be eclipsed by the output of 1926, but there is every reason for satisfaction at the sustained position of the mineral industry.

The principal factors in the result are coal, coke, silver-lead-zinc, and limestone-cement. It was thought that, with the close of the year 1926, the aggregate value of the minerals produced in the State should approximate £424,500,000.

It is estimated that the output of coal in the State for 1926 would turn out to be approximately 10½ million tons, or about three-quarters of a million tons below the output recorded in 1925. That total is considered highly satisfactory when the leeway which the industry had to make owing to the general stoppage on all the fields is taken into account. Of the estimated output approximately 7 million tons were won in the Northern District, almost 2 million tons in the Southern District, and a little over 1¼ million tons in the Western District. These figures would indicate a falling off of some 300,000 tons in the Northern District, and approximately 100,000 tons in each of the Southern and Western Districts. The total output of the collieries in the State from the opening of the coal seams to the end of 1925 is estimated at 311,150,000 tons. About 23,500 miners are engaged in the coal mining industry.

The coke trade languished during the latter end of 1925 and the early part of 1926, but towards the close of the latter year the prospects of an increased production had considerably brightened owing to an alteration in the methods of coke manufacture.

The shortage of water hampered operations at the Broken Hill mines during the earlier months of the year, but otherwise work was carried on continuously with marked success. The production from the larger mines increased, and it is anticipated that the total tonnage of silver-lead ore and concentrates and zinc concentrates obtained will slightly exceed that of the previous year, when 277,000 tons of silver-lead ore and concentrates and 266,000 tons of zinc concentrates were won. This output was valued at £6,335,000. The average prices of lead and spelter fell somewhat below the average of 1925, and the value of the production was, therefore, probably less than that of 1925.

The prospecting and development work conducted during the year was responsible for satisfactory additions to the ore reserves of several of the more important mines. The tonnage of ore raised at Broken Hill during the year is estimated at 1,288,000 tons, or an increase of 23,000 tons as compared with 1925. In December the number of men employed totalled 5948, being over 100 more than the number engaged for the corresponding period last year.

Increased activity was manifested on the various tin fields consequent upon the high price ruling for the metal. An increased production and a well augmented value should therefore be recorded for 1926. Additional hydraulic sluicing plants were installed in the New England District for treatment of the alluvial deposits. The production for 1925 was valued at £250,944.

As regards the other branches of metalliferous mining, the low price ruling for copper militated against the successful working of the deposits, and although gold mining still continued to come in for some measure of attention, no discoveries of importance have been recorded. The production appeared, however, to be of the same scale as that of preceding years.

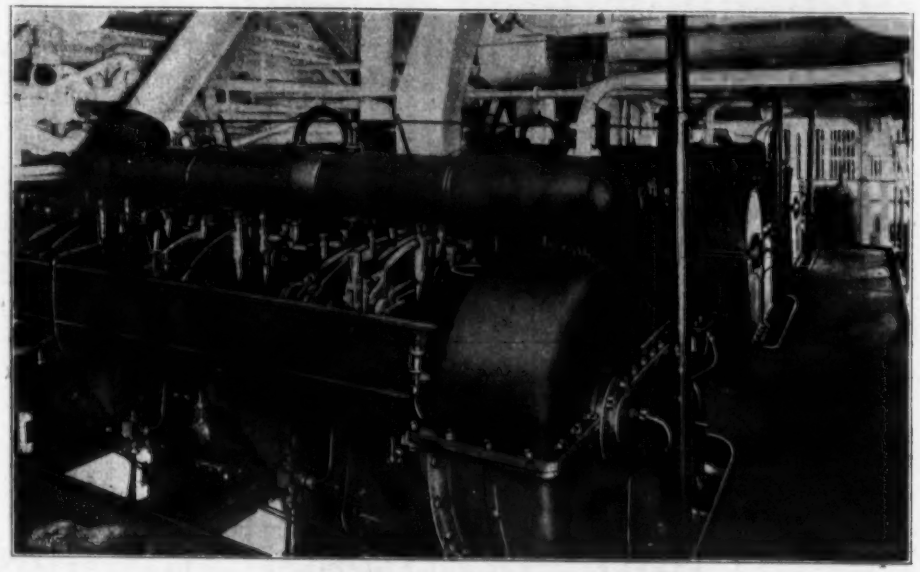
In the year 1925 the output of Portland cement reached 304,000 tons, valued at £1,320,000, and was the highest recorded up till then, but with the additions made to existing plants and another company added to the list of producers, a substantial increase in production should be recorded for 1926.

Mention has also to be made of the mining for platinum, opal, and the various other minerals, all of which helped in the aggregate materially to swell the year's production. Following on the general expansion of trade it is expected that increased production will be evidenced in respect of the output of the various quarries, including building stones, road material, and clays used for the manufacture of bricks, pottery, &c.

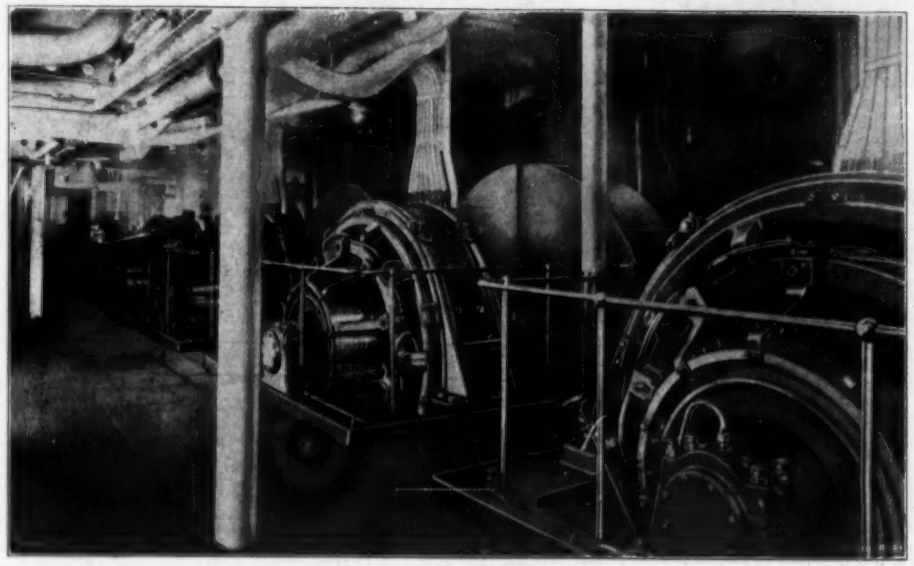
THE AUXILIARY AND MAIN PROPELLING MACHINERY OF THE ROYAL MAIL LINER ALCANTARA

HARLAND AND WOLFF, LTD., BELFAST, ENGINEERS

(*For description see opposite page*)

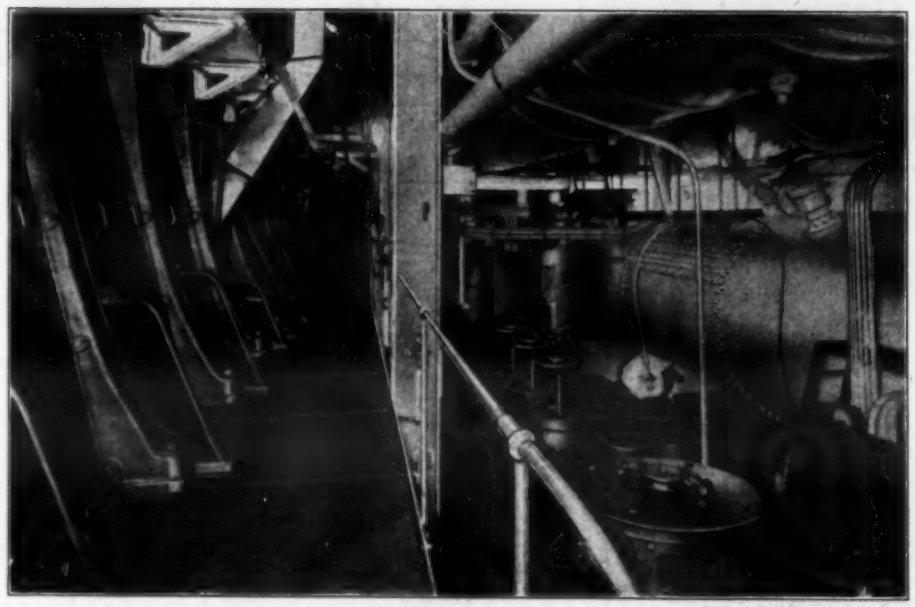


TOP PLATFORM IN AUXILIARY ENGINE-ROOM



430 K.W. GENERATORS IN AUXILIARY ENGINE-ROOM

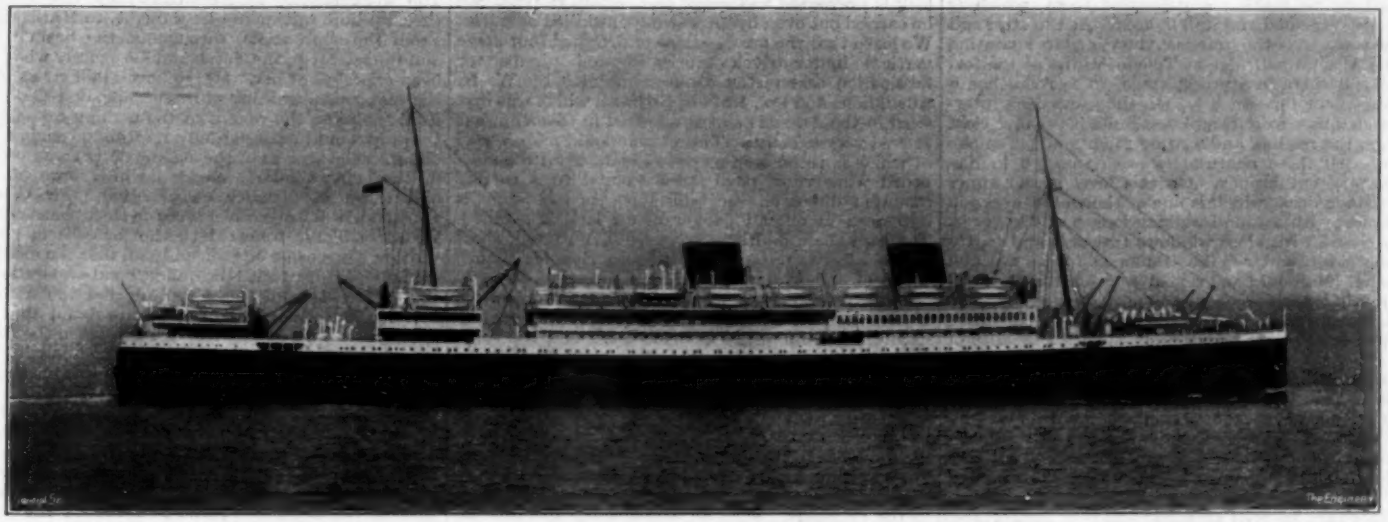
STARBOARD ENGINE CONTROLS, MAIN ENGINE-ROOM



VIEW IN STARBOARD WING OF MAIN ENGINE-ROOM

THE ROYAL MAIL TWIN-SCREW MOTOR LINER ALCANTARA

HARLAND AND WOLFF, LTD., BELFAST, BUILDERS AND ENGINEERS



The Royal Mail Motor Liner Alcantara.

THE new 22,000-ton twin-screw motor liner Alcantara, which took the water at Harland and Wolff's yard at Belfast on September 23rd, and completed her fitting out towards the end of the year, was on Friday last, February 18th, formally handed over to her owner, the Royal Mail Steam Packet Company, of London. On the preceding day successful speed trials and a twenty-four hour full-speed endurance trial were carried out, and the machinery operated in a very satisfactory manner, all main and auxiliary units performing a non-stop run. On Saturday morning, February 19th, the Alcantara left Belfast Lough for Southampton with a party of guests, and arrived at the latter port early on Monday morning. We were privileged to accompany the vessel on her round trip, and in what follows we give some of our impressions of the new liner and her propelling machinery. In the table below the principal particulars of the ship and her engines are given :—

Hull Particulars.

Overall length	655ft. 8in.
Length between perpendiculars	630ft. 6in.
Breadth, moulded	78ft. 5in.
Depth, moulded	40ft. 5in.
Displacement	32,000 tons
Gross tonnage	22,180 tons

Main Propelling Machinery.

Type	Twin-screw Harland-B. & W. 8-cyl., 4-cycle D.A. motors
Cylinder, bore	840 mm. (33in.)
Cylinder, stroke	1500 mm. (59in.)
Designed speed of engines	105–115 r.p.m.
Total output—I.H.P.	20,000
" " S.H.P.	15,000
Speed of ship	About 16½ knots

Electric Generator Sets.

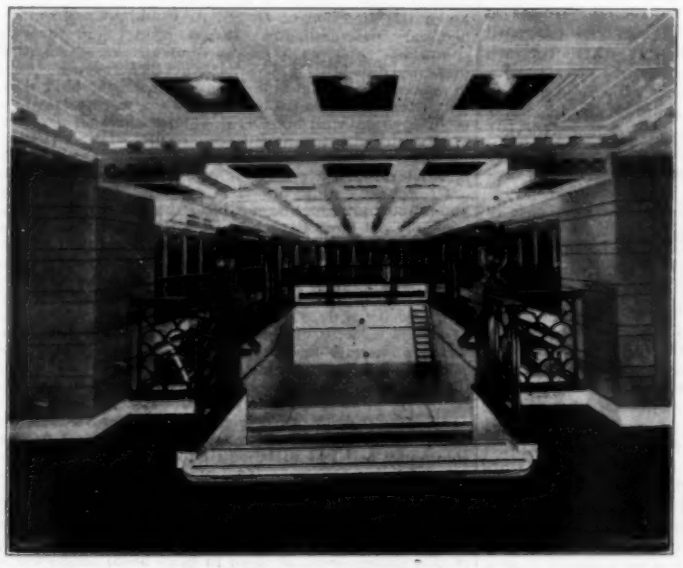
Main generating sets	Four at 400 K.W.
Emergency set	One at 75 K.W.

In practically all respects the Alcantara is a sister ship to the Asturias, which was described and illustrated in our issue of February 26th, 1926. She differs somewhat, however, in the decorative treatment of her public rooms, and some detailed improvements have been effected in her main engines, to which reference will duly be made.

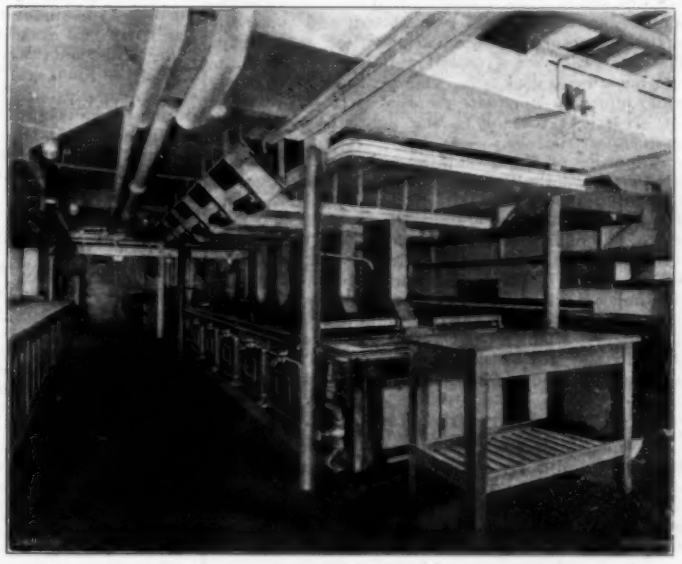
From the broadside view of the liner, which we reproduce above, a general idea of her appearance may be obtained. Her two low funnels, well-proportioned superstructure and cruiser stern will be observed. The ship is built of steel to the most recent requirements of the British Board of Trade and the Spanish authorities, and she embodies the latest provisions for navigation and safety at sea. The hull is divided into twelve water-tight compartments by eleven bulkheads, while the double bottom is carried right fore and aft and is arranged for the carriage of fresh water or water ballast as may be desired. Adequate fire protection measures are provided in the passenger, hold and machinery spaces. The boat accommodation is in keeping with the most recent Board of Trade regulations, and special flood lights are fitted for illuminating the lowered boats. On the main boat deck there are twenty-four lifeboats, including two motor lifeboats fitted with wireless gear. Most of the boats are nested in pairs, and Welin type davits are used with Vanguneo electrically operated boat-lowering gear. In the way of the second-class accommodation and also right aft, further lifeboats are carried. Boat accommodation for the full ship complement of about 1900 persons is carried. An interesting navigational device is the Admiralty type echo-sounding gear, which was supplied by Henry Hughes and Son, Ltd., London. The receiver is fixed in the chart room and the ground transmitter in the skin of the ship below the engine-room. The depth of water is given by recording the time taken for a sound to travel from the ship to the bed of the sea and back again. We may also refer to the wireless telegraph equipment. It consists of a standard 1½-K.W. Marconi quenched spark and valve transmitting unit, which will ensure the maintenance of communication with land throughout the voyage. A Marconi direction finder is also fitted. The apparatus is normally worked from the ship's supply mains, connections being made to both the main and emergency switchboards. In case of both sets being shut down a battery equipment is carried by which signals can be sent.

THE PASSENGER ACCOMMODATION.

The first-class passenger accommodation occupies the whole of the centre part of the ship, and it is arranged on six decks A to F. Further aft are the second-class public rooms and cabins, whilst right forward very comfortable accommodation for third-class passengers is provided. The portal for first-class passengers is on B deck, and gives access to the large entrance lounge, which runs the full width of the ship. From this comfortably furnished room one obtains a good view of the dining saloon, whilst a main staircase and an elevator gives access to all six decks, from the swimming pool on the orlop deck to the top boat promenade deck and observation decks. At the after end of the first-class accommodation a similar staircase is arranged, enabling the smoke-room and the winter garden to be conveniently reached. In this entrance we noted an illuminated track chart, which displays a small ship worked from the electric clock system, showing the exact position of the vessel at any time during the voyage. We need hardly refer in detail to the cabin and public room accommodation, for in the main it differs little from that of the Asturias. We may remark, however, on the large size of the first-class dining saloon, and the social hall two decks above it. The dining saloon on A deck is an apartment 94ft. long, with a breadth of 74ft., with a central hall some 60ft. by 40ft., having a two-deck height of 17ft. The remainder of the room is one deck in height. A dignified colour scheme in old ivory has been carried out, and the lighting, both in the day and the evening, is very artistic in appearance. Directly above the dining saloon is the social hall, which is entered from the upper promenade deck, or



THE SWIMMING POOL



VIEW IN FIRST-CLASS GALLEY

E deck, and the main forward staircase. This room, which is also two decks in height, is Spanish in character, and is panelled in Cuba mahogany, after the style of the Chapter House at Toledo. The high windows in the recesses and the stone fire-places all contribute to making a delightful room, which is fittingly furnished and well lighted. At the after end of the room, over the stairway, there is a large painting of the Alcantara Bridge at Toledo, whilst at the forward end there is a raised stage. The room has a parquet floor for dancing. On the same deck interconnected by corridors and vestibules is the first-class lounge, the reading and writing room and the smoke room. All these apartments are decorated in distinctive period designs. On this level is the upper promenade deck, which is one of the widest decks in existence, with a round walking length of 220 yards. It is closed with glass windows forward, and partly at the sides, and can be employed for games and dancing. Marconi hand repeaters are fitted for relaying music to the deck from any part of the ship. We show on page 211 a view of the swimming pool on the orlop deck. It has a length of 29ft., with a breadth of 17ft. and a depth of 8ft. The general style is Pompeian, and the ceiling lighting is novel in character. Another pleasing room is the winter garden on the boat promenade deck, or F deck. It is surrounded by tall windows, is decorated in the Spanish Renaissance style, and it is lit by electric lanterns of a design copied from old Spanish naval lamps. The second and third-class accommodation aft and the third-class forward are well arranged and very comfortable cabins and public rooms have been provided.

Deck Auxiliaries.

All deck auxiliaries are electrically driven with the exception of the cargo cranes, which are of the hydraulic type, supplied by Fullarton, Hodgart and Barclay, Ltd., of Paisley. A full description of these cranes and automatic motor-driven hydraulic pumps will be found in our issue of March 26th last. The steering gear is of the Harland Hastie hydraulic-electric type, built under the Hele-Shaw-Martineau patents. Clarke, Chapman and Co., Ltd., of Gateshead, supplied the electrically-operated anchor windlass and warping winch, and also two electric capstans, port and starboard, which are arranged on the after deck. The emergency lighting and power unit consists of a four-cylinder Harland-B. and W. single-acting four-cycle engine, with cylinders of 260 mm. bore and 250 mm. stroke. It is coupled direct to a Laurence Scott 75 K.W. generator. Alongside the set is a five-panel switchboard, with interconnections to the main switchboard and the main auxiliary motors for the various deck machinery. The emergency set is placed well above the margin line on a main deck aft. This position, it is stated, while affording adequate security is to be preferred for structural reasons to the lighter decks in the main superstructure.

A feature of the Alcantara is her well-equipped kitchens and galleys. A view in the first-class galley is given on page 211. In the foreground will be seen one of the new island-type electric ranges. This particular range, one of five in the various galleys, has a total frontage of 53ft. It was supplied by Henry Wilson and Co., Ltd., of Liverpool. In addition to the electric ranges there are bakers' ovens, salamanders, grills, fish fryers and toasters, as well as motor-driven kitchen machinery. Right aft is the ship's laundry, most of the machinery for which was supplied by Thos. Bradford and Co., Ltd., of Manchester.

Main Propelling Machinery.

The main propelling machinery is of the standard Harland-B. and W. eight-cylinder four-cycle D.A. type, the power developed—15,000 S.H.P.—being such as enables the usual twin-screw arrangement to be adhered to. The sizes and outputs of the engines are given in the preceding table. Since the Asturias was completed almost a year ago with similar machinery, oil engines of the same type have been successfully installed by Harland and Wolff, Ltd., in no less than four other liners, including the Alcantara, while the firm has on hand orders for several more engines. The experience gained with the Asturias has shown that no alteration to the main design was necessary, but some interesting improvements in detail have been made. On entering the engine-room from the main working alleyway, we noted that the long sheet steel manifolds for the air intakes have now been done away with, and in their place short inlet pipes with narrow perforated slits are fitted to each inlet valve. The air is taken in on the undersides of the inlet pipes, and any heated air is thus entrained at top platform level at sixteen points in the engine-room. A similar arrangement has been introduced for the air intakes for the bottom inlet valves, and these inlets are built in a rectangular form. They are furnished with perforated slits, and air is drawn from the region of the bottom valve gear and cylinder covers. By employing such intakes any fumes arising from chance lubricating or fuel oil on the valves are at once entrained. A supply of fresh air is brought in at the lower part of the main engine-room through the shaft tunnel, and circulation is effected throughout the engine-room spaces by powerful extraction fans. We found the engine-room, which we inspected several times during the voyage, to be thoroughly well ventilated. A small improvement has been made in the reversing arrangement at the starting platform, shown in a lower view on page 210. Instead of piston valves, positive-closing valves are now fitted for the reversing servo-motor air controls, so that any air leak is prevented and quick and certain reversal can be carried out even by an entirely unskilled operator. We learn that the arrangement of drowned four-stage vertical motor-driven lubricating oil pumps for lubrication and piston cooling, supplied by W. H. Allen, Sons and Co., Ltd., of Bedford, which was first tried in the Asturias and is repeated in this ship, has proved very effective. The oil pump and motor—one of which is to be seen at the right hand of the starboard wing view, page 210 is secured to a casting mounted direct on the tank top. As the pump is immersed in oil, all danger of air lock is avoided. The cam shaft is driven from the main crank shaft at the centre of the engine by two Renolds chains, each 3in. in width. Each chain is designed to carry the full driving load with a high factor of safety. During a year's running of the Asturias engines hardly any stretch has been detected and the drive is a very silent one. Another alteration concerns the method of driving the mechanical lubricators for the main engine cylinders. They are mounted at the back of the engine, and each is chain-driven from the indicating shaft. The timing of the lubricators is so arranged that oil is delivered to the cylinder during either the exhaust or air inlet stroke, as may be most convenient, when there is no heavy pressure in the cylinders. Such an arrangement has proved, we learn, beneficial for both liner and piston ring lubrication. A minor improvement concerns the injection air bottles, which are grouped at the forward end of the starting platform. They are now slightly raised above floor-plate level, so that access is given to the lower ends for cleaning and inspection, as required. The main generating sets are four in number, and are placed in a separate engine-room forward of the main engines. They comprise Harland-B. and W. four-cylinder, four-cycle S.A. engines, coupled through an intermediate bearing to the 400 K.W. 220-volt generator. The top views on page 210 show the upper platform and the generator ends of the sets. The engines have a cylinder bore of 500 mm., with a stroke of 750 mm., and are designed to give their full output at a normal speed of 165 r.p.m. When at sea, three units more than suffice to furnish current for the heating, cooking and lighting of the ship, while when in port one set is generally employed. In two compartments at the after end of the auxiliary engine-room there are Cochran type steam boilers, fitted for oil burning on the Clyde oil fuel system. A large switchboard gallery runs the full width of the ship at the forward end of the room and control panels are provided for the principal groups of machinery. Two electrically driven refrigerating machines, supplied by J. and E. Hall, Ltd., of Dartford, supply cooled brine for ice-making, provision storage chambers and the insulated hold spaces for the carriage of chilled and frozen meat.

Machinery Performance.

Throughout the whole time we were aboard the Alcantara the machinery ran extremely smoothly, the main engines varying in speed from 96 to about 105 r.p.m., according to the weather conditions. On some occasions it was necessary slightly to reduce the power of the engines when passing through patches of fog, but the main part of the voyage was done at approximately working speed. We are in a position to state that the fuel consumption at sea for all purposes works out at from 68 to 70 tons of Diesel fuel oil per day of twenty-four hours. When in port the total amount of oil fuel which is required for all purposes amounts to about 4 tons per day. The fuel consumption of the main engines, which has been checked for several liners with similar engines running under service conditions, would seem to show that a figure of 0·39 lb. of fuel per S.H.P. can now be expected. It is also found that there is a slight reduction in the fuel consumption after the first voyage, which is probably explained by the fact that the operating staff of engineers are more accustomed to handling their engines and that probably slightly higher cylinder jacket temperatures and piston cooling oil temperatures are maintained, so that less heat is rejected in the cooling media. We noted that at all times the exhaust from the silencers in the after funnel was entirely smokeless, showing that good combustion was taking place. The only smoke we observed was during the first few moments of lighting up one of the auxiliary boilers.

The figures above quoted certainly show that for a liner of this size and speed, oil engine machinery effects a marked saving in the amount of oil fuel used.

On the last evening at sea on Sunday, February 20th, Mr. E. N. Lubbock, of the court of directors of the Royal Mail Steam Packet Company, was chairman at dinner, and in a short speech he referred to the enterprise of his company in constructing at a time of some industrial unsettlement the Asturias and the Alcantara, her sister vessel. The success which had attended the first ship had encouraged the company in the feeling that the decision to meet growing foreign competition in the South American traffic was a right one. He expressed the hope that the Alcantara would prove to be an equally successful and popular ship. Replying on behalf of the builders, Mr. E. F. Rebbeck paid a tribute to the excellent team work which had been put into the ship by all at Belfast. The workmanship and craftsmanship displayed in the ship bore testimony, he thought, to British skill. From the shop trials, throughout the basin trials, and the trial trip, the ship had done exactly what had been expected of her. Mr. Rebbeck laid stress upon the economical working of these ships, and said that, in his opinion, the weight of the earning capacity of the ship would outweigh any matters of engineering detail. The success of the engine design was proved in the ships similarly engined which were at sea and those now under construction. Sir Charles Hipwood, of the Mercantile Marine Department of the Board of Trade, referred to the increase in recent years of ships using oil fuel, and said that the relations of his Department with the builders and owners during the construction of the Alcantara and the Asturias had been most cordial. There is no doubt that the new liner will occupy an important place in the Royal Mail fleet. She is not the first of the company's ships to carry that name, and on board we saw an interesting relic of the earlier ship H.M.S. Alcantara, which was employed as an armed cruiser, and on February 29th, 1916, was sunk with the German ship Greif in a single-handed fierce fight off the coast of Norway. It is the key of the Captain's cabin, which was presented to the Royal Mail Company by Rear-Admiral Thomas Erskine Wardle, D.S.O., who commanded the vessel during the action.

SIXTY YEARS AGO.

The successful laying of the Atlantic telegraph cable in 1866 had, according to a note in our issue of February 22nd, 1867, provided a new means of determining the difference of longitude between England and America. Previously estimations of the difference had rested upon chronometric expeditions, instituted by the United States Coast Survey in 1849–51 and 1855. During these expeditions fifty chronometers were transported across the Atlantic three times in each direction. The probable error of the result obtained from the observations made with the chronometers was ninteen-hundredths of a second of angle equivalent to a linear distance on the earth's surface of about 190ft. The value for the relative longitude obtained in this way was sufficiently accurate for most purposes of the time, but even in those days astronomy was refined to a degree which demanded a more accurate measure. To achieve the desired result by means of the Atlantic cable parties of the Coast Survey were formed under the direction of Dr. B. A. Gould to perform the necessary measurements. It was soon found that the submarine cable as a means of determining longitude presented difficulties and obstacles not hitherto encountered in making similar determinations by means of land lines. For a time a successful outcome to the work seemed exceedingly doubtful, but Dr. Gould's genius and perseverance eventually triumphed, and results of "remarkable precision" were obtained. The probable error of the new determination was given at about four-hundredths of a second, or, as interpreted in our note, the distance of about 1900 miles had been measured and the measure was probably not more than 40ft. from the truth. Incidental to the investigation the time required for a signal to pass through the cable was determined with increased precision to be 31/100ths of a second with a probable error of 1/100th second. This figure, it was stated, was equivalent to a velocity of 6020 miles a second, and was notably less than the velocity of "the electric fluid" in land lines which numerous observations showed to average 16,000 miles a second. By velocity of the electric fluid in land lines the writer presumably meant to imply the speed of signalling in such lines and not the speed with which a continuous current of electricity flows along a conductor, which speed, until Einstein came along to upset us, was commonly believed to be equal to the velocity of light, 186,000 miles a second. To-day we are no longer content to measure merely the relative longitudes of two places but seek by means of wireless instead of cable signals to discover whether and to what extent relative longitudes are subject to change of a regular or irregular nature. Tests of this nature were, or were to have been, conducted at the end of last year by the International Astronomical Union and the International Geoditic and Geophysical Union. So far we have not heard the results of these tests.

LOCOMOTIVE BOILER TUBES.

The British Engineering Standards Association has published revised editions of the British Standard Specifications for Charcoal Iron Lap-welded Boiler Tubes (No. 43) and for Cold-drawn Weldless Steel Tubes for Locomotive Boilers (No. 53). The principal difference between the old and new issues of both specifications is the inclusion of standard sizes and thicknesses for boiler tubes, and tolerances on their thickness and external diameter, but whilst the specification for cold-drawn weldless steel tubes has been drawn up so as to cover testing requirements for superheater smoke and element tubes, standard sizes for these tubes are not included.

The tensile strength for steel tubes, whether the test is made on pieces of tube or strips cut from the tubes, has been raised to 26 tons per square inch and a minimum of 20 is now specified. The minimum elongation required on pieces of tube remains the same as before, namely, 28 tons per square inch, but in the case of strips cut from the tubes the minimum has been reduced to 22 tons per square inch. Copies of these revised B.S. Specifications (Nos. 43 and 53) may be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, S.W. 1, price 2s. 2d. each post free.

Railway Matters.

ANSWERING a question the other day, the Prime Minister said that there was no intention to dissolve the Ministry of Transport, but that the position of Parliamentary Secretary to the Ministry would not be filled.

THE guaranteed week for the railwaymen, which was suspended by agreement last May, is to be gradually restored. A four days' week is assured as from Monday last; on March 14th a five days' week will operate, and on April 11th the full week.

IN order to provide against the loss likely to arise during the current year owing to contracts for foreign coal that have run into 1927, the directors of the London, Midland and Scottish Company have transferred a further £1,700,000 from the general reserve. The London and North-Eastern has also made similar provision to the amount of £1,700,000.

THE annual report of the Metropolitan Railway Company shows that it proposes to spend £76,000 this year out of capital on additional rolling stock. Last year the sum so expended was £23,500. It is observed that the work of replacing one of the 5000-kilowatt turbo-generators at Neasden power-house by a machine of 15,000-kilowatt capacity was completed during the year, and a satisfactory reduction in the consumption of coal per unit generated has resulted therefrom.

WHAT is known as the upper quadrant movement of railway signal arms, i.e., their being raised above the horizontal when put to "clear," was introduced into this country on the Metropolitan Railway, but until now it has not been employed except in three-position automatic signals, *e.g.*, on the Ealing and Shepherd's Bush line. The system is now, however, to be introduced into two-position mechanical signalling on the London and North-Eastern and made that company's standard.

ON the motion for adjourning the House of Commons last night (Thursday) week, Colonel Ashley dealt with the wagon supply trouble. He said that when the coal stoppage ceased the railways rushed large amounts of coal to the industries and merchants, but domestic coal was not bought to the extent that was expected, and thousands of wagons were left under load in the depôts. On February 10th there were 7523 loaded wagons in the depôts of London and a further 3915 wagons were awaiting acceptance.

SOME irritation was caused last week by the "census" that was taken on the Underground. Its purpose may be understood—and possibly forgiven—if we say that most of the tickets now issued are available by various routes, and it is only by such a census that the varying proportions can be known. The practice is quite a common one where "foreign" companies exercise running powers, *e.g.*, as the Midland did over the Lancashire and Yorkshire, to see how many local passengers use the "foreign" trains.

AN unusual incident occurred on February 9th on the London Electric Railways at Camden Town. It is assumed that a spark from a brake shoe set fire to some paper or other rubbish on the track near the air supply for the operation of a pair of points. As a consequence of the weakening of the pipe the compressed air therein burst it, and the points became inoperative and had to remain in the position in which they were lying at the time. The trains, as a result, were held up, and there was for about half an hour considerable delay.

THE London, Midland and Scottish Company, by taking £7,188,000 from reserves, is paying 3 per cent. dividend for the year 1926, as compared with 6 per cent. in 1925 and 7 per cent. in 1924. The Great Western has absorbed about £2,250,000 and also pays 3 per cent., but that is against 7 per cent. a year ago, 7½ per cent. in 1924 and 8 per cent. in 1923. The Southern pays 5 per cent. on its preferred stock, which is the same rate of distribution as in 1925, but 1¼ per cent. on the preferred as compared with 3¼ per cent. The London and North-Eastern has had to take nearly £7,000,000 from reserves in order to pay the interest and dividends on the debenture, guaranteed and preference stocks and a nominal distribution of one-eighth of one per cent on the preferred ordinary.

OF the three months of the quarter ended June 30th last, the first—April—was under normal conditions; the other two suffered from the general strike and the coal stoppage. The influence of the latter abnormal conditions is shown in the number of accidents. Instead of the Assistant Inspecting Officers of the Ministry of Transport holding, as in the June quarter, 1925, forty inquiries into accidents to railway servants—of which fourteen were fatal cases—there were only twenty-three inquiries and five fatal accidents. Undoubtedly, the inspecting officers, because of the conditions, refrained from troubling the companies, except in serious cases, but the reduction from fourteen to five in the number of fatal accidents inquired into shows how the figures were affected by the stoppage.

THE Ministry of Transport inquiry into the Hull railway disaster of the 14th instant was conducted by Colonel Sir John Pringle yesterday (Thursday) week. From the evidence given by the signalman concerned, it would appear that the Scarborough train got on to the line on which the train from Withernsea was approaching as a consequence of No. 95 points being in the wrong position. The signalman concerned was certain he had not moved the lever, and he added that since the accident he had been trying to think out how it was possible for it to get there. The Inspecting Officer offered the suggestion that the man had pulled No. 95 lever when he had intended to use No. 96. Sir John observed further that if the man had done so nobody with a fair mind could come to any other conclusion than that it was a sheer mistake. It should be noted that the signal-box in question is power operated on the electro-pneumatic principle. The signalmen working there spoke very highly of the working, and there does not appear to be any reason for suspecting that the signalling was out of order. The coroner's inquest was opened on Tuesday, the 15th, and was resumed last Wednesday. After hearing considerable evidence it was adjourned until March 16th. Two more victims of the disaster have died, raising the number of deaths to twelve.

Notes and Memoranda.

WHAT is regarded as a record output from one mill is claimed by the Clydebridge Steel Works of David Colville and Sons, Ltd., of Cambuslang, which recently turned out in one week 5600 tons of steel.

AT one of the irrigation schemes on the banks of the Orange River a Diesel oil engine burning whale oil is used for pumping. It is said to run quite satisfactorily without any alteration. The price of the oil locally is £9 a ton.

A NEW type of electric safety lamp was recently displayed in Vienna, in which the filament is made up of a series of semi-circular loops of palladium and the bulb is stopped with a disc or porous stone. The base fits the standard lamp socket. In a normal atmosphere, the ends of the filament show dark red. When methane gas, the deadly fire damp, is present in the air, the centre of the filament becomes brilliantly incandescent, and when 8 per cent. or more of methane gas is present, the centre of the filament continues to glow after the current is turned off.

THE magnesite beds of Manchuria, states the *Chemical Trade Journal* and *Chemical Engineer*, are estimated at about 20,000,000,000 tons. A study of the output has shown that it compares creditably with foreign products. It was first experimented upon at the S.M.R. Co. Central Laboratory as material for firebrick. Next the experiment was extended to the manufacture of Sorel cement, which is used for making the substitute for linoleum known as lignoid. Experiments are being pursued in the making of magnesium carbonate, magnesium sulphate, metallic magnesium, &c. The problem of how to turn these experiments to practical account is to be taken up by the Laboratory this year.

IN the cold storage of fruit for long periods it is important that the temperature should be kept uniform within comparatively narrow limits, in order to avoid, on the one hand, the risk of freezing, and on the other the danger of a too rapid ripening of the fruit The problem is by no means so simple as might be supposed. A recently issued report gives a detailed account of the actual variations of temperature, at different points and at different times, in a number of English fruit stores refrigerated by different systems. The data obtained enable certain suggestions to be offered for securing a more uniform temperature, which should be of value in the design and operation of refrigerated fruit stores. The results should be considered in relation to those obtained in ships' holds, which are being published in a separate report.

CANADIAN coal mines produced 18 per cent. more coal in 1926 than in 1925, according to production figures now available. In 1926 the output was 16,105,000 tons, compared with 13,134,968 tons in the previous year. The 1926 production was distributed as follows:—Nova Scotia, 6,810,000 tons; Alberta, 6,117,000 tons; British Columbia, 2,634,000 tons; Saskatchewan, 376,000 tons; New Brunswick, 168,000 tons. During the year Canada's total importation of coal amounted to 17,520,000 tons, and her total exportation was about 900,000 tons. Of the total imports 17,120,000 tons came from the United States, and the remaining 400,000 tons from Great Britain, Germany and the Netherlands. The total amount of coal made available for consumption during the year, according to the Dominion Bureau of Statistics, was 32,725,000 tons.

THE great development of the pulpwood and water-power resources of the Province of Quebec are illustrated in a report issued by the Lands and Forest Department of the Government of Quebec. The forestry resources of the Province of Quebec occupy more than 130,000,000 acres. It is estimated that 22,000 square miles of forest lands will in time become available for agriculture, and the extent of that area may be realised when it is remembered that the present agricultural territory of the province is 18,000 square miles. Of the forests of the Province the Crown is still the biggest owner. Individuals own 9795 square miles, colonists have 2023 square miles on location tickets, and the Crown has 191,772 square miles. Turning to water-powers, while much has been done in the way of development, much more still remains to be done, for of the 15,000,000 horse-power available the development has been up to 1,800,000 horse-power only.

A NEW use for ilmenite-bearing iron ores is covered by a patent in which E. C. Eckel describes the manufacture of a quick-hardening chemically resistant cement by smelting in a blast-furnace titaniferous iron ore with enough lime and aluminous material to form a titanium-calcium-aluminium-iron slag, which consists essentially of calcium titanate (TiO_2, CaO) with subordinate quantities of ferrites, aluminates, and calcium silicate, and contains 2 to 10 per cent. of iron oxide. The remainder of the iron is reduced to metal and drawn out below as in ordinary smelting. The slag, finely ground, forms "titan cement." It is claimed that if the lime is kept below 50 per cent., preferably about 30 to 40 per cent., the cement hardens rapidly after a normal set, attaining high strength in twenty-four to forty-eight hours; that at all periods it is stronger than Portland or alumina cements; and that its resistance to chemical attack is higher than that of either Portland or alumina cement. The specific gravity is given as 3·35 to 3·55.

THE *Mining Review* of the South Australian Department of Mines for the half year ending June 30th, 1926, recently issued, contains an interesting summary of what is known regarding the coal and lignite resources of South Australia. Apparently the only true bituminous coal so far discovered lies at very considerable depths covered with highly water-bearing Tertiary sediments, which appear to render its economic exploitation impracticable. There are three occurrences known as sub-bituminous coal, apparently of Triassic age; this coal appears to be only of moderately good quality, the moisture as mined ranging from nearly 9 per cent. to more than 30 per cent., and the ash from more than 6 per cent. to more than 18 per cent.; a sample which has been tested gave 7460 B.Th.U. per pound as mined, a figure which compares very unfavourably with ordinary bituminous coal. A number of occurrences of Tertiary lignite are known; apparently the only attempt at actual mining has been done in the Moorlands field, and the coal has been extensively tested, but the results do not appear to have been satisfactory.

Miscellanea.

THE first of the towers for the transmission line from the Shannon to Dublin was erected on the 15th inst. at Stepaside, Co. Dublin.

COAL shipments from the Tyne in January were 1,348,286 tons, or an increase of 150,965 tons over the corresponding month of last year.

THE wharf which it is proposed to build on the river Ouse in connection with the new colliery at Thorne Moorends, will have accommodation for two 2000 steamers.

IT is claimed that a record for a British coal pit was established recently by the Brodsworth Colliery, Doncaster, when 6450 tons of coal were raised in one working day of two shifts.

SINKING at the new colliery at Upton has just reached a depth of 500 yards. The Shafton and Cudworth seams have already been passed, and it is hoped to reach the Barnsley bed at a depth of 720 yards.

AN effort is to be made shortly to extract the ore which is known to exist in the huge mounds to be seen round about the ironstone mines in Cleveland. The necessary screening machinery is being made by a Gateshead firm.

A REVIVIAL of the mining industry in Newfoundland seems possible in view of the optimistic reports of development companies regarding lead and zinc mines, and of the Government geologist regarding deposits of iron ore in the Avalon Peninsula.

A CONFERENCE of European wireless engineers will shortly be held under the auspices of the International Radio Union to examine the position of high-power European stations working on long wave lengths. Russian delegates are expected to attend.

THE electrical generating plant by which the Gas Light and Coke Company, Ltd., utilises waste heat from gas producers in its Beckton Works is to be extended by the addition of a 2500-kilowatt turbo-alternator set which has been ordered from the Metropolitan-Vickers Electrical Company, Ltd.

WIRELESS stations in the South Seas, states the American consul at Tahiti, now broadcast copra quotations, which are picked up by the trading schooners amongst the Society Islands, and enable the buyers to deal on narrower margins than was possible when only the occasional cable offices kept them in touch with the market.

A WIRELESS message was recently received from the commander of the Royal Mail Steam Packet Company's motor vessel Asturias, 22,500 tons gross, which is at present on a world cruise, stating that the vessel called at Tristan da Cunha on February 15th. The Asturias was the first ship to call for twelve months, and the largest that had ever called.

A FURTHER extension in the Transatlantic telephone service took place on Saturday, February 12th, when the service became available to and from all places in the States of Michigan, Illinois and Wisconsin. The charge for a call from Great Britain to any place in these States is £15 12s. for the first three minutes, and £5 4s. for each additional minute or fraction thereof.

ONE of Stockton's three idle shipyards is shortly to reopen, Craig, Taylor and Co., Ltd., having secured an order for two new vessels. This welcome announcement, coming after so extended a period of stagnation in the industry locally, is a great relief to the whole community. The order is for two steamers of 8400 tons each, and has been secured from a Cardiff firm of shipowners. The engines for these vessels, too, will be built at Stockton, Blair and Co., Ltd., having obtained the contract.

THE Mines Department has published a preliminary statement—subject to minor corrections—of the number of deaths caused by accidents in and about the mines and quarries of Great Britain, including the Isle of Man, during 1926. In all 707 separate fatal accidents, causing 1145 deaths, were recorded at mines and quarries last year, as compared with 728 accidents and 1233 deaths in 1925. As regards the causes of accidents in and about the mines under the two Acts, five deaths were due to explosions of firedamp or coal dust, 334 to falls of ground, 30 to shaft accidents, 132 to haulage accidents, and 84 to miscellaneous accidents underground. The number of deaths due to miscellaneous causes on the surface at mines was 76 last year. The number of deaths in and about quarries was 67.

THE exhibition of scientific apparatus recently arranged by the Junior Institution of Engineers revealed quite a collection of instruments in which no engineer could fail to take an interest. Six firms exhibited apparatus, and by means of the "guide" of varicoloured sheets, one was able to find with little trouble what there was to be seen. One of the most fascinating things to watch in operation was the Brewerton Course Recorder, which marks out the course of a ship to scale on a chart. Another instrument of impressive capabilities was the "Eotvos" torsion balance used for the location of mineral and other deposits by measurement of their gravitational pull. The machine works itself entirely and records its readings photographically. The Midworth distant repeater and the Venner-Shotter water flow meter, shown in operation, were but two of many other instruments of interest.

TO the Paisley Association of Electrical Engineers, Mr. Robert Hardie, of the Glasgow Corporation Electricity Department, recently lectured on "The Electrical Industry in the U.S.A." The lecturer described the conditions prevailing in the large cities of Canada and America, and compared the consumption of electricity for domestic purposes, shop window lighting, street lighting, flood lighting for advertising, factories, &c., with similar consumption in Britain. Comparisons of the kind, of course, do not favour this country. Domestic consumers in America were encouraged to use all kinds of domestic apparatus, which was mostly sold on the hire-purchase system; and the wiring of houses was also carried out under this system. In one large city fully 90 per cent. of the houses were wired. Lamps, again, were sold in the U.S.A. at a very low price compared with the cost in this country, so that every encouragement was given to the householder to use electricity lavishly.

SUSPENSION BRIDGE OVER THE RIVER DELAWARE

(*For description see page* 202)

FIG. 4—READY FOR SPINNING THE CABLES, AUGUST, 1924

FIG. 5—ERECTING THE STIFFENING TRUSSES, APRIL, 1925

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SIXTEEN-PAGE SUPPLEMENT—"THE METALLURGIST."

The Metallurgist

THE FEBRUARY NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

DEATH.

February 15th, JESSE SANDERS BROWN, one of the directors of G. A. Harvey and Co. (London), Ltd.

THE ENGINEER.

FEBRUARY 25, 1927.

Co-operation in Science and Technology.

A CONSIDERABLE number of our readers have, no doubt, received from the National Union of Scientific Workers a circular which it has issued within the last few days, whilst others must have seen references to the communication in the daily Press. The object of the circular, which is signed by eminent men of science in all branches, is to ascertain if an enlargement of the activities of the Union would meet with sufficient support. The membership of the Union in the eight years of its life has not reached the magnitude which was anticipated. It is stated that there must be in Great Britain nearly 10,000 persons qualified to become members, and yet at the present time there are barely 1000 names upon the roll. The Union—a designation which, it appears, has led to some slight misunderstanding—was established in 1918 "To promote the cause of science in our national life and to improve the status of the scientific worker." It is rather surprising that a body professing such objects should have made such relatively slow progress when we recall the frequent complaints that science is neglected in Great Britain and that the remuneration for its services are scandalously below its merits. We can scarcely believe that the modest annual subscription of thirty shillings does indeed—as the circular suggests—cause the reluctance of the "younger members of the profession" to join. Rather would it seem that the complaints to which we have referred are not very widely held or that a very small proportion of the critics are sufficiently moved by them to venture one pound ten per year upon the removal of their sources.

With the objects of the Union—which, we ought to say at once, is non-political, but has definite economic and cultural aims—we have a great deal of sympathy. Any organisation which is endeavouring "to improve the status of men and women of science, and to aid the cause, both nationally and internationally, of science itself, both pure and applied," is engaged upon work which is as desirable as it is disheartening. For many years enthusiasts have endeavoured to win for science recognition equal with that enjoyed by trade and even superior to it. They have failed and in all probability will continue to fail. The world admires science, but it is not prepared to pay much for scientific ideas, and it is only when science is converted into some material thing that can be sold "across the counter" that it becomes profitable. In other words, it is not till science is converted into trade that there is money in it, and then, more often than not, the trader, not the scientist, gets the cash. But apart altogether from the probability or improbability that the Union will succeed in materially improving the status of science, the extended activities which it has in view deserve support. Let us glance at them for an instant. "If," says the appeal, "the Union could speak for a united profession, it would be more successful in obtaining representation for scientific workers on all bodies set up to consider problems of national, Imperial, and international importance. It could make a comprehensive survey of the whole field of research and report on the types of fundamental research likely to lead in the near future to important advances in knowledge and the means most likely to promote them. It could play a valuable part by examining and criticising the activities of Government Departments and other organisations concerned with the encouragement and applications of science. It could draw up a code of professional ethics. It could make a complete register of all those engaged in work demanding for its performance an adequate training in science. In all these ways the Union could undoubtedly become of the greatest scientific and national importance, without trespassing in any way on the functions of existing organisations." It is necessary merely to state these objects to appreciate their value. Occasions arise when science is in conflict with other interests; with no unity it is unable to make effective opposition. Again, there is, on the one hand, overlapping of work and not a little wasted endeavour; and on the other, ignorance by one branch of science of the experiences of another branch, with, as a consequence, loss of a stimulus to the imagination and sometimes even of the clue to a problem. Would Faraday and Edison have made the discoveries and inventions for which they are famous had not they both begun as chemists; would James Watt have been as great an engineer had he neglected physics; or Kelvin as great a physicist had he been ignorant of mechanical engineering? There is no single profession which is not the better for contact with another profession. The engineer who knows nothing of metallurgy limits his scientific imagination; the metallurgist who does not follow the problems of engineering restricts his capacity for useful work; the naval architect who never considers the propelling machinery works at diminished efficiency. So on all through the technical and, probably, other professions. The bishop, the doctor, the lawyer who extends his studies into other subjects than those proper to his profession is a better, because a wider, man than he who concentrates too exclusively on one subject. If the Union can do aught in the extended field which it has in view to further the intercommunication of scientific ideas and to effect co-operation it will perform a valuable service for its country.

But whilst the wider issues are being handled by a body which comprehends all science and technology, a great need will still remain for the separate branches to strive for harmony of endeavour. In engineering there is already, on the one hand, too much dispersedness of effort and, on the other, too intensive specialisation. In this country alone there are nearly one hundred societies and institutions interested in engineering and its allied subjects. Between these bodies there is little or no co-operation. They do not even know completely each others seasonal fixtures and clashing of engagements is by no means a rare occurrence. On various occasions efforts have been made to secure some kind of harmony, to establish some kind of bond between allied bodies; but so far with very little result. Even the great parent institutions work in close compartments, and it is only at rare intervals that joint meetings are arranged. When any great issue of importance to all the institutions arises—as, for example, that of the status of engineers in the Royal Navy—a special committee has to be formed. Such a committee may speak for, let us say, some twenty-five thousand engineers, but does not represent all the branches of engineering and kindred technology in the kingdom. Again, there is great diversity of effort on scientific and technical subjects, and no co-ordinating body to combine those

efforts and make them more effective. In such a material thing as libraries alone there is waste by duplication, or limitation by the lack of concentration of funds. It is now not unusual to hear the opinion expressed that there are far too many institutions, and as Mr. Reavell, the immediate Past-President, touched upon the need of establishing some form of bond between the various bodies in his speech at the annual dinner of the Institution of Mechanical Engineers, we have reason to hope that at length definite steps will be taken to explore the whole subject and, we trust, to establish a scheme for bringing all the societies of a fitting status into harmonious relationship.

Chemical Analysis.

ONE of the earliest stages of the application of science to industry, especially to metallurgical industry, was the introduction of chemical analysis as a means of controlling the quality of raw materials and of products, as well as of following the progress of metallurgical processes and reactions. So much did this application precede other and more general uses of science, that to this day in many works any scientifically trained man is indiscriminately known as "the chemist." While this is, for many reasons, unfortunate, it must be realised that chemical analysis still retains its high importance in many branches of industry, and is still a matter worthy of consideration from the standpoint of the engineer. There is, naturally, a strong tendency for practical men to say that they are not interested in the chemical composition or even in the mode of manufacture of a given engineering material, such as steel, so long as it shows the physical qualities which they desire. This is an entirely logical attitude if only it were possible to determine precisely what are the physical qualities of a given batch of material, and what exactly are the qualities desired by the engineer. But unfortunately neither is at present entirely possible. We can and do ascertain whether random samples taken from the batch conform to certain simple specified mechanical tests. These are designed, so far as our existing knowledge goes, and as far as the limited conditions of commercial testing allow, to determine those qualities which the engineer wishes to secure in his material for a given purpose. But when this has been done much remains unknown and would remain open to serious doubt were it not that long practical experience has shown that materials which give certain test figures, and have a certain chemical composition, are, on the whole, safe and reliable. But here the question of chemical composition cannot be ignored, especially as our past experience is based almost entirely on material purchased under specifications in which close limits of chemical composition were stated. If, therefore, we were to abolish or lessen the stringency of these composition clauses in our specifications, relying solely on the standard mechanical tests, we should be sacrificing one of the factors which correlate our information about new material with past experience, and that is a step not to be lightly taken.

There is, not unnaturally, some degree of pressure from manufacturers, especially in the direction of securing greater freedom in regard to chemical composition and method of manufacture, which in the case of steel at all events are closely interconnected. No doubt progress in metallurgical processes has made it possible at the present time to produce materials of entirely satisfactory properties by processes which were for a long time regarded as of doubtful reliability. Basic steel is, of course, the outstanding example of this kind. There is also the fact that modern knowledge of the effects of hot and cold working and of heat treatment leads to the conclusion that the effects of such treatment may be more important than slight variations of composition, and that it is, consequently, far more important to secure safeguards against bad treatment than to insist upon stringent limits of chemical composition. But if we give the fullest weight to considerations of this kind, the matter of chemical composition still retains its very real importance. It is true, for instance, that a slight excess of either sulphur or phosphorus content over that required by most specifications seems to make no appreciable difference to the behaviour of steel under the usual mechanical tests. Nevertheless, records of cases of failure in service give a clear indication that high phosphorus content may be dangerous, while, on the other hand, high sulphur content is likely to be associated with numerous non-metallic inclusions, and we are coming to recognise with increasing clearness the very undesirable effects of these particles of foreign matter. Something might, indeed, be said on similar lines in regard to the other impurities which are usually analytically determined in steel, but it is not necessary to go into further detail in order to stress the point. So long as there is any reason to think that certain impurities may have an effect on the service performance of a material, while scarcely affecting its response to routine tests, there is good ground for the retention of chemical composition clauses in our specifications, and it may well be questioned whether the restriction of such clauses in many steel specifications to sulphur and phosphorus is wise. The whole question, however, deserves consideration from another aspect. If it is true that impurities produce subtle effects which are important in service, but do not affect routine tests, then there is need for the closest investigation, both as to the exact nature of the effect which such impurities produce and as to the reason why such an effect is or may be missed by our mechanical tests. The latter point, of course, is already under constant investigation, as the stream of papers describing researches on methods of testing serves to show. The former question is much more difficult and raises a point of first-rate importance as to chemical analysis itself. We do not refer now to the old idea that analysis, as regards its finer points, is liable to be uncertain and that different analysts will give widely varying results. Recent evidence on this subject, derived from the comparison of analyses by chemists all over the country on samples of steel undergoing examination with a view to use as analytically standardised samples, has shown conclusively that, given a truly homogeneous sample of steel, competent analysts do not disagree appreciably as to its composition, so far as the impurities which are ordinarily determined are concerned. The question we wish to raise relates rather to the current practice of analysis, which applies to other materials besides steel, of determining a certain conventional list of impurities and calling the result an "analysis" of the material. Broadly speaking, the metallurgical chemist finds only what he looks for—he does not seek ordinarily to find what the metal under analysis contains, but sets out to determine merely how much of each of a certain list of impurities is present in his sample. In routine analytical work nothing else is possible, since anything like an exhaustive analysis would become prohibitively expensive and difficult. Now the point is that these lists of impurities to be determined in a given material have been in vogue for a great many years, and it may well be that by this time they require thorough revision.

This is not work that can be done by those engaged in routine analysis of commercial material. It demands the collaboration of the most skilled of chemists, equipped with all modern aids, such as the ultra-violet spectrograph and modern methods of using the X-ray tube as a means of analysis, as well as metallurgists familiar with the methods of production of the metal concerned and with its treatment prior to use, and of engineers familiar with the behaviour of the material under use and test. Such a combination could set out with good hope of success to investigate the presence and effects of impurities or ingredients existing in commercial metals, and in steel in particular, whose presence is, in current analytical practice, either unknown or ignored. It may be that they would obtain a negative result; that they might find the current list satisfactory. But there are indications to the contrary. Nitrogen and other gases, oxides and other substances are frequently invoked by research workers and others to explain apparently anomalous results. But is enough known about the effects of these elements to justify the inclusion of an oxide or a nitrogen determination in routine analysis? Or can a steelmaker, for example, secure the uniformly higher quality of his product by controlling the content of these substances in his steel? It may be that something of the kind lies at the basis of the manufacture of a new type of steel abroad, for which it is claimed that it is free from certain undesirable properties which exist in ordinary mild steel. These differences are, it is claimed, demonstrable by test and by service behaviour, but a difference in composition is not detectable by ordinary analysis, nor is there much scope for wide differences of mechanical or thermal treatment in the manufacture of boiler plates. Interesting possibilities of this kind may perhaps add the zest of immediate practical interest to a question which we have raised on somewhat general grounds.

Literature.

Beiträge zur Geschichte der Technik und Industrie. V.D.I Year Book. Vol. 16. By CONRAD MATCHOSS, V.D.I. Verlag, G.m.b.H. Berlin, N.W. 7. Price 16 Marks.

UNLIKE the preceding volume in this series of annual historical reviews, which was devoted to the Rhineland and its industries, the book before us is remarkable for its very wide range of interests. In his introduction Dr. Conrad Matchoss comments with evident pleasure on the increasing number of workers and the keen interest which is now being displayed in the history of engineering and technology. In Germany a considerable impetus to this movement has undoubtedly been given by the opening of the Deutschen Museum in Munich, and mention is made of the literary research programme which has been planned in connection with the work of the Museum. Although evidently inspired by the work which is being done in his own country, Dr. Matchoss is appreciative of the kindred work of the Newcomen Society in England, and he recalls the valuable historical activity which was associated with the recent Railway Centenary Celebration.

The book that we are reviewing is a volume which contains some three hundred and fifty pages, with no less than a hundred and seventy-five illustrations. It opens with a biographical study of the life and work of the famous scientist and teacher, Franz Grashof, while early in the book there is another article which is devoted to the life and pioneer work of the engineer and armour-plate manufacturer, Hermann Gruson, of Magdeburg.

An historical account is given in another article of the construction and working of the 128·8 kilom. 3½ft. gauge wood and iron railway between Budweis and Linz, which was the first railway of its kind to be constructed. Two contributions of chemical interest are those dealing with the early history of spirit distillation and the utilisation of wood with special reference to the production of cellulose.

A more modern note is struck in two short articles which deal respectively with the technical development of oil fuel firing and the history of electrical lifting appliances. The development of the calculating machine, the history of fire extinguishing, and the very early history of the lightning conductor, are dealt with in other parts of the book. There is also an account of the early coal industry in Germany, with historical references, which date back to the sixteenth century. Two other articles, which give some account of very early investigators, are those on Biringuccio and Giuliano da San Gallo, two engineers of the fifteenth century; while in another part of the book there is an interesting article on water engineering in early Egyptian times. The volume closes with a series of seven short histories of famous German engineering firms, which is followed by a review of references to apparatus and inventions of historical interest that have been taken from books new and old. There is an alphabetical index of some one hundred and fifty references to historical articles which were published in the technical literature of 1925, while an index is also given of the contents of the present sixteen volumes of this important series of historical works.

SHORT NOTICES.

Design and Construction of Form Work for Concrete Structures. By A. E. Wynn, B.Sc., A.M. Am. Soc. C.E. London: Concrete Publications, Ltd., 20, Dartmouth-street, Westminster, S.W. 1. 1926. Price 20s.—This is a book which deals with a subject about which comparatively little has been written, and it deals with it in an exhaustive manner. The formwork or shuttering for all kinds of structures are considered, including those for footings; columns; walls; beams and girders; floors; buildings; slabs; conduits; sewers and culverts; tanks, silos, bins and stand-pipes; dams, piers, and heavy walls; curved surfaces; and arches and bridges. It is voluminously illustrated with half-tone engravings, dimensioned drawings and sketches of a practical nature, which have evidently been prepared by an engineer who is well acquainted with the matter in hand. From internal evidence, we should judge that the writer is from the United States, or, at any rate, that he has had considerable experience with conditions in that country. That he is an associate member of the American Society of Engineers points in the same direction. But let it be said at once that because many of the illustrations given to show different types of construction have nearly certainly come from across the Atlantic, we do not consider that as detracting in any way from the value of the book, which we should describe as being a thoroughly practical and workmanlike discussion of the subject.

THE long-disputed question of the privately owned wagon is likely now to be brought to a head by the appointment, as recommended by the Coal Commission, of a Standing Committee on Mineral Transport, of which Sir Arthur Duckham is the chairman. The railway representatives on the Committee are Mr. R. Bell, assistant general manager, London and North-Eastern Railway; Mr. J. Milne, assistant general manager, Great Western Railway; Mr. G. S. Szlumper, assistant general manager, Southern Railway; and Mr. E. Wharton, mineral traffic manager, London, Midland and Scottish Railway. Mr. J. H. Thomas is also a member.

The British Industries Fair.

No. I.

As Mr. Vyle said at the luncheon on the occasion of the Press view of the British Industries Fair at Birmingham on Friday of last week, it required a considerable exercise of imagination to judge what was going to be shown on the stands, as the buildings were chaotic in the extreme. Many of the stands were quite bare, while others, which had been finished, were sheeted up and the gangways were littered with packing cases or obstructed by trenches cut for the laying of cables or pipes. During the week-end, however, by dint of hard work, the place was straightened up, and on Monday, the 21st, it was reasonably tidy. The Fair, by the way, is to be open until March 4th.

It is, of course, again being held in the old aerodrome buildings at Castle Bromwich, but they have been very considerably extended since the last exhibition, by the addition of extra bays, 73ft. wide, roofed over with Belfast trusses, while the "B" and "C" buildings are now virtually made one by a roof connecting the two throughout their width. The long corridor between buildings "A" and "B" however, still remains. The result of these alterations is that the buildings now cover an area of about 6 acres, and there is accommodation, which has all been taken up, for 600 stands, as compared with 400 stands last year. Incidentally, the entrances have been greatly improved, and the road journey out from Birmingham facilitated by the completion of the new bridge over the canal.

In general character the Fair closely resembles its

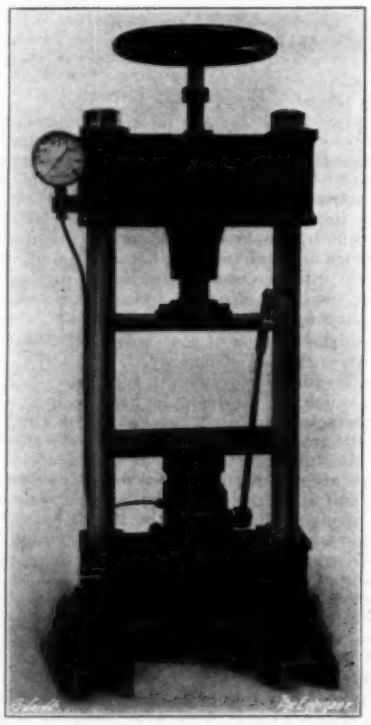


FIG. 1—EXPERIMENTAL HYDRAULIC PRESS—TANGYE

predecessors, and there are practically all the exhibitors who have supported the Show in the past, while we noticed a number of new names familiar in the engineering world. There is, however, one novel feature for the Fair, and that is the model steam power station. It is a development of the same idea which was recently staged in the Bingley Hall, Birmingham; but it is considerably more imposing. Besides boilers and the other plant connected with the raising of steam, there are at Castle Bromwich two turbo-alternators of 750 and 250 kilowatts respectively, two steam engines and dynamos, a two-cylinder oil engine, a 1000-kilovolt-ampère transformer, and a vertical boiler under steam, besides a large variety of auxiliary plant. We shall revert to this part of the exhibition in greater detail on a future occasion.

Another characteristic of the new Fair is the large proportion of heavy machinery exhibited, and that is probably the explanation of its unreadiness last Friday. Besides the usual show of fair-sized gas engines, there are now, over and above the plant in the model power-house, such substantial items as a large planing machine, some heavy wood-working sets, several big testing machines, and so forth. It speaks well for the courage of our engineering manufacturers that, after their experiences at Wembley, they should go to the expense of installing all this heavy machinery at Castle Bromwich for a show which lasts only a fortnight. But this is only one instance of the increased interest in the Fair which is being shown by the engineering industries and which has resulted in a most excellent exhibition.

It is noteworthy that there is a very considerable increase in the number of electrical firms exhibiting, and in the class of power, lighting, heating, cooking and ventilating, which numbers 114 stands all told, no less than 85 are electrical. In the engineering group there are 134 stands, besides the 35 exhibits of the model steam power plant; so, it will be seen, mechanical engineering, as distinct from the manufacture of hardware, is well represented.

Before going on to our description of the exhibits, it may be as well to point out that this is a Fair, and is intended to foster trade rather than to be a technical exhibition. As a consequence, the exhibitors naturally show such items as they think will sell most readily. In many cases those items have been

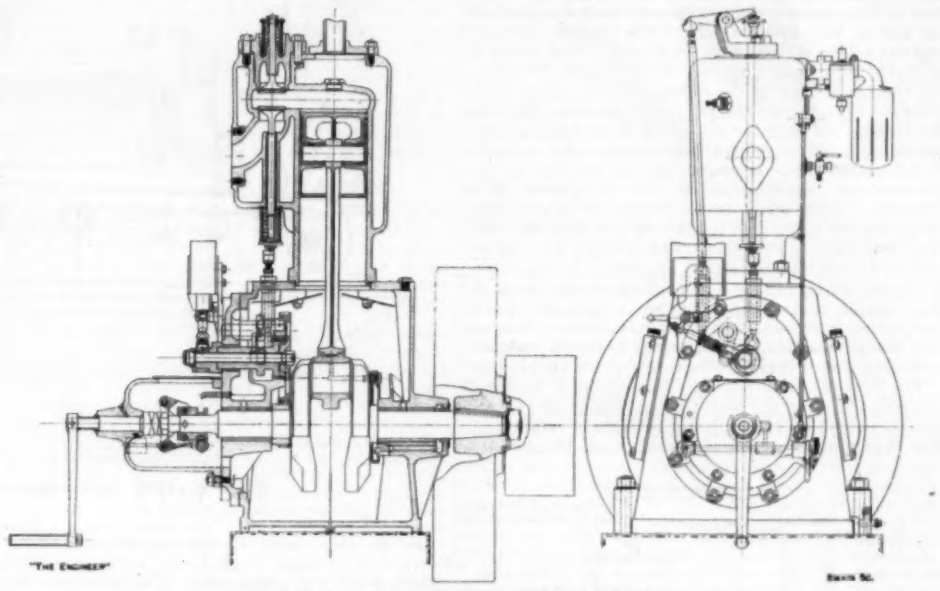


FIG. 2—31 B.H.P. VERTICAL GAS ENGINE—NATIONAL

well tried, and may be familiar to our readers; but, following the spirit of the Fair, we propose, so far as is possible, to give some account of the more important exhibits, whilst avoiding too much semblance to a mere catalogue.

On the stand of Tangyes Ltd., Birmingham, there are two oil engines, one of 47 horse-power, and of the cold-starting type, while the other is started by means of a blow lamp. There is also a variety of pumps, jacks, pulley blocks and hydraulic presses. The oil engines do not call for much comment here, as we have dealt with their leading features in connection with previous exhibitions, but it may be as well to explain that the cold-starting engine is put into motion by compressed air in the usual manner, but as the air in the cylinder at the end of the compression stroke would not be sufficient to bring about ignition of the injected fuel oil, a small quantity or super charge of air is admitted to the cylinder at or about the beginning of the compression stroke which causes the pressure of the air charge to be raised to such an amount, that ignition of the fuel oil will take place. The admission of the super air is continued only during the starting of the engine, which takes some ten to fifteen seconds. During this period the combustion chamber has become so warm that when the super compression starting valve is put out of operation, the combined heat of the now warm combustion chamber and the heat obtained at the lower compression is sufficient to bring about ignition of the injected fuel oil, and the engine continues to run in the normal way. By means of this super-compression starting of the engine, it will be gathered that, although the air in the engine cylinder is compressed to such a pressure as to bring about ignition when starting from a cold state, this compression is considerably reduced during the normal working of the engine. The compression during the normal working is therefore some 20 per cent. below that required for the starting, and the pressure on the bearings and the stresses on the several parts of the engine are correspondingly lessened.

The hydraulic press, also on this stand, which we illustrate in Fig. 1, has been designed for experimental purposes, and is capable of exerting a total pressure of 40 tons. As will be seen from the engraving, it is of the built-up type, the head and base being constructed of rolled steel channels, while the head is supported from the base by turned steel columns secured by nuts. The platens, guided on the columns, consist of mild steel plates, the bottom platen being secured to head of a ram, and the top platen being fitted with a screw working in a bush in the press head, and provided with a hand wheel for adjusting the amount of daylight or distance between the platens to suit the different classes of work done. The press cylinder is of forged steel with a mild steel ram, and a cistern containing the pressure pump which operates the press is secured to the press cylinder. The pressure pump is operated by hand. The pressure gauge registers not merely the pressure per square inch, but the total amount of pressure on the press ram. The ram is 4in. in diameter, and has a travel or lift of 6in., the amount of "daylight" or distance between the platens is 15in. the space between the columns is 18in., and the width of the platen 12in. The press exhibited is designed for a working load of 35 tons, and has been tested to 40 tons, but this type is made in several other different sizes and capacities. In order to suit the nature of the work being dealt with, it is sometimes necessary to apply heat whilst the articles are being pressed, and in such cases boxes can be fitted to the faces of the platens, which can be heated by hot water, steam, gas or electricity, whichever may be available.

The engines shown at Castle Bromwich by Petters, Ltd., of Yeovil and Ipswich, include one heavy oil set of 70 B.H.P. and another of 12 B.H.P. There is a 24 H.P. marine engine, and some smaller sets. The two larger engines and a small lighting set are shown running.

The National Gas Engine Company, Ltd., of Ashton-under-Lyne, shows two oil engines and two gas engines. The former are of 66 B.H.P. and 31 B.H.P. respectively, and their general design was described in THE ENGINEER in connection with the last Fair. One of the gas engines is connected to a Wallwin non-chokeable pump, while the other is driving a dynamo. We give a drawing of this engine in Fig. 2. As will be seen, it is of the vertical type, and works on the

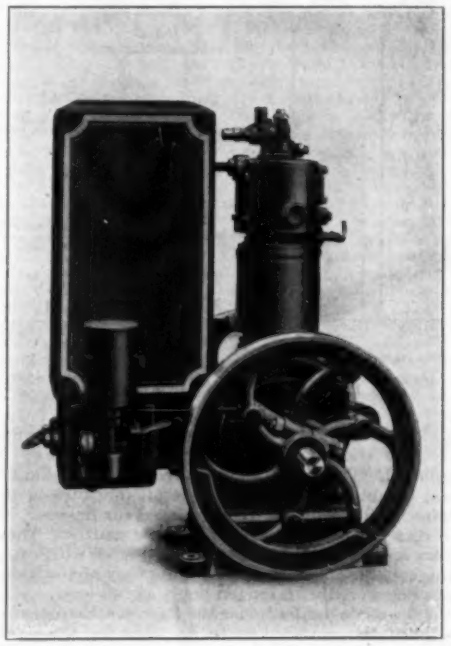


FIG. 3—4½ H.P. AIR COMPRESSOR—BLACKSTONE

four-stroke cycle. The valves are in line, one above the other, with the inlet valve on the top and the exhaust below. A separate push-rod and rocker lever is used to actuate the inlet valve, and there is a special mixing valve for providing the proper proportions of air and gas. These engines are made in several sizes ranging in output from 2½ H.P. up to 9 H.P. continuous rating.

Blackstone and Co., Ltd., of Stamford, have a collection of oil engines, some of which are of the spring-injection type already described in our columns, of both horizontal and vertical types, the vertical embodying a new form of exhaust valve gear, to which we hope to revert. They also

exhibit the little air compressing set illustrated in Fig. 3, and a new type of filter for dealing with heavy fuel oils. The compressing set is primarily intended for charging the air bottles used in starting large oil engines, but could, of course, be used for any other purpose where fairly high-pressure air is required. It comprises a 4½ horse-power vertical two-stroke petrol engine, combined with a two-stage air compressor. The air cylinders are arranged horizontally, and can be seen in the illustration below the cooling tank. The engine cylinder is 4½in. in diameter by 5in. stroke, while the compressor cylinders have bores of 3½in. and 1⅝in., with a stroke of 5in. The speed is 550 revs. per min., and the output is 9 cubic feet of free air per minute delivered against a pressure of 450 lb. per square inch. The engine is easily started by hand, and runs on petrol. The petrol is mixed with a small quantity of oil—about 1 to 30—for the lubrication of the motor and first stage compression cylinder by the petrol-oil system. Stauffer lubricators are used for the crank shaft bearings and crank neck. The second stage compressor cylinder is lubricated from a small cup on the top of the compressor. Ignition is effected by means of a magneto. The speed is controlled by a governor operating on a throttle regulating the mixture from the carburetter. The compressor is fitted with safety valves to obviate excessive pressures in the intercooler or pipe line to the bottle which is being charged. The engine and compressor are cooled by water circulating from one tank common to both. This set will charge two 15in. air bottles up to 450 lb. pressure in 30 minutes or from 250 lb. to 450 lb. in 12 minutes.

The fuel oil filter tank on this stand is intended not only to filter out any foreign matter in the oil, but also to warm up the latter to make it more fluid. For that purpose a branch is taken off the exhaust

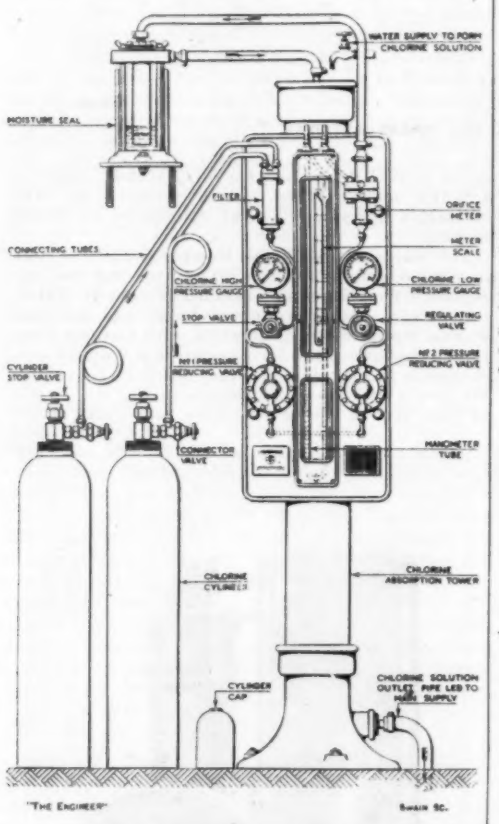


FIG. 4—CHLORONOME—PATERSON

pipe of the engine it serves and is fitted with a flap valve, so that the temperature of the oil may be regulated. There is a separate receptacle, inside the main chamber, for holding light oil for starting the engine, and this oil can also be used for flushing out the dirt which collects on the filter gauzes. These filters are made in various standard sizes with capacities capable of running the engines they are intended to be connected with for ten hours at full load.

In the model boiler-house the Paterson Engineering Company has a water-softening plant for the treatment of boiler feed supply comprising a lime-soda plant, having a capacity of 1500 gallons per hour. The plant shown is an actual installation under working conditions, complete with an Osilameter measuring and chemical supply gear, wood fibre strainers and sludge settling arrangements. There is also displayed a model of the by-pass type Osilameter measuring and chemical supply gear for the addition of lime and soda ash as installed in connection with large water-softening plants of 5000 to 100,000 gallons per hour capacity. Another exhibit is a Paterson "Basex" base-exchange water softener, designed to produce a water of zero hardness. The new "Basex" softening material used in this plant is claimed to possess to a much greater degree than usual the characteristics of a natural base-exchange material, and is a natural earth product so treated as to enhance its sensitivity and stability, and it is practically indestructible. It is stated to be completely unaffected by CO_2 and weak acids, and to be free from the objectionable characteristic of many base-exchange softening materials, viz., of imparting appreciable quantities of silica to the treated water. "Basex" can be regenerated in the short period of 20 minutes after an eight-hour run, and the activity of the material is such as to reduce the salt consumption to a low figure.

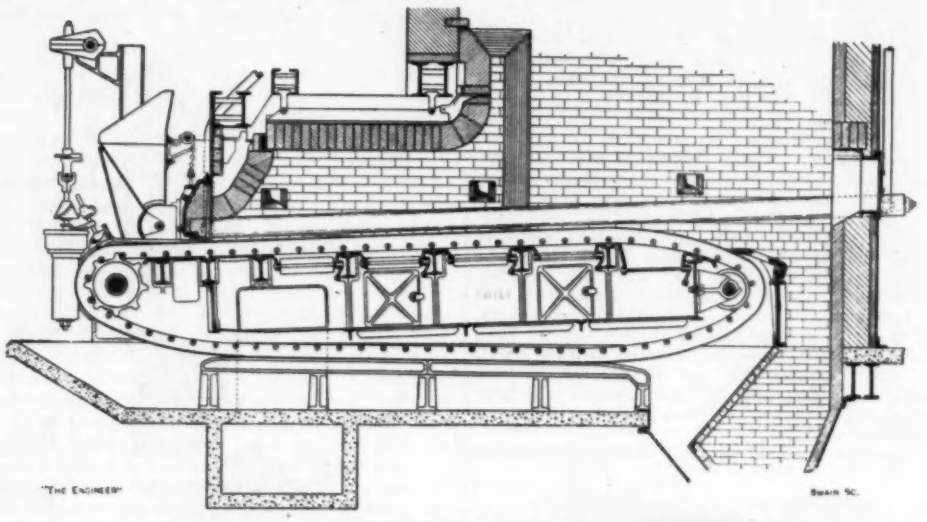


FIG. 5—H.-TYPE TRAVELLING-GRATE STOKER—UNDERFEED STOKER CO.

On its stand next to the model boiler-house the Paterson Company is exhibiting a pressure filter as installed for the purification of sedimentary waters for boiler feed supply and manufacturing purposes, while another exhibit is the Chloronome, illustrated in Fig. 4, for the continuous sterilisation of condenser cooling waters to prevent organic growths on the condenser tubes by means of the addition of a measured trace of chlorine gas. The amount naturally varies with different waters, but is of the order of 1 in 3,000,000 parts by weight. This treatment, it is claimed, helps to maintain a continuously high vacuum in the turbine, obviates the necessity for shutting down the plant at frequent intervals for cleaning, and so affects a considerable saving in fuel costs by reducing the quantity of fuel consumed. The

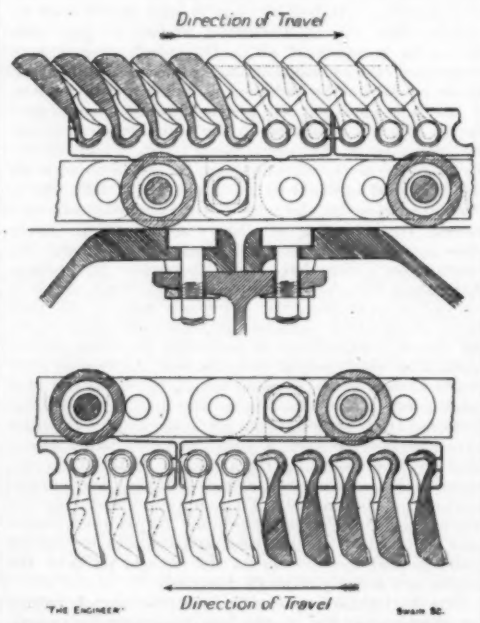


FIG. 6—CROSS SECTION THROUGH TRAVELLING GRATE

system is being used with similar success in power stations where water cooling towers are installed.

The action of the apparatus is as follows:—The compressed chlorine gas, which is stored in steel bottles, is led to a control board, where it first passes through a filter. It then goes through a stop valve and two reducing valves, which bring down the pressure to 10 lb. per square inch. There are gauges on both the high and low-pressure sides. From the regulating valves the chlorine passes through a special fitting containing a silver diaphragm plate, having an orifice of predetermined size. A connection from either side of the diaphragm is led to the two limbs of a manometer tube, and the difference of pressure set up by the rate of flow of the gas causes a displacement of the liquid contained in this tube. The movement of the liquid column indicates on a graduated scale the exact flow of gas in pounds per hour. Each scale is calibrated from the orifice with which it is to work, so as to ensure the utmost degree of accuracy.

The gas, after passing through the orifice, is conducted through chlorine-resisting tubing to a moisture seal containing an inert liquid, through which it bubbles, and is then led to an absorption tower of glazed earthenware, which is fitted at the top with a water distributing tray, and is packed with pumice. The super-chlorinated solution flowing from the base of the absorption tower is conveyed through chlorine-proof piping to the point of application, and a distributor is fitted to ensure the efficient mixture of the super-chlorinated water with that requiring treatment. The manometer tube is of special design and construction, and is provided with a device to make it impossible for the liquid to be blown out of the tube by careless or inadvertent manipulation. This device is of importance, because the blowing of the liquid into the mechanism would not only put the instrument out of action, but might entail partial dismantling for cleaning purposes.

Among the exhibits of the Underfeed Stoker Company, Africa House, Kingsway, London, W.C. 2, the most interesting is the new H type travelling grate stoker, which we illustrate in Figs. 5 and 6. The chief characteristic of this stoker lies in the formation of the grate bars, which are arranged transversely across the furnace in short lengths of about 12in. The bars are of a peculiar cross section, as shown in Fig. 6, and are attached to the travelling chains by means of pivot pins. The bars, it will be seen, can back, one against another, so that their upper ledges form the grate, with narrow spaces between for the admission of air to the fire. The bottom edge of each bar is curled up to form a trough, and in this recess any small riddlings, which may work through between the bars, are caught. The riddlings are carried forward with the grate, and when the bars drop over, as they pass the back tumbler, they are dumped into the ashpit. The lower view in Fig. 6 shows plainly how this dumping effect is produced.

Underneath the stoker there is a large enclosed wind box for providing a forced draught, which reaches throughout its width and length; but the intensity of the draught through the several zones of the fire can be regulated by dampers arranged immediately beneath the active part of the grate. These dampers are interconnected crossways and are operated by gear along the sides of the furnace in such a manner that the draught must be evenly distributed across the width of the fire. One of the chief claims for this stoker is the fact that it can be made in widths up to as much as 24ft., while any tendency for the fire-bars to grow in thickness is immaterial, as such a growth is easily taken up by the bars assuming a more vertical position.

On November 30th last a London, Midland and Scottish rail motor train was approaching Crofton South Junction, Wakefield, when it was derailed. It was then found that the front left-hand brake hanger was broken in two places, and that the broken half of the hanger fouled a check rail near the point of derailment and carried the rail forward, with the result that there was nothing to guide the wheels at a through crossing and the derailment resulted. Major Hall, in reporting on the accident, says that there were two fractures, one of which showed signs of an old crack over the greater part of the area. That had been, at some time, electrically welded inside, but the work had been so indifferently carried out that the old metal had not run, with the result that the original fracture remained, covered with an irregular skin of deposited metal. As a result of the accident the railway company has decided that at the periodical shed examinations, the brake hangers shall be dismantled for examination.

Hydro-electric Progress in Canada During 1926.

A YEAR of widespread activity in the field of hydro-electric and water power development in Canada is again evident from a review prepared by the Dominion Water Power and Reclamation Service of the Department of the Interior, of which the following is a fairly full summary. While the total additional installation throughout the Dominion did not reach the record figure of the preceding year, it was, nevertheless, substantial, being just slighty under 266,000 horse-power, which brings the total installation in Canada to 4,556,000. While the figure of actual installation is considerable, it falls far short of indicating the magnitude of constructional activity during the year. Projects are actually under way, a number being near completion, which will ultimately add to the Dominion's total more than 1,700,000 horse-power, while others in active prospect promise a further addition in excess of 1,000,000 horse-power. These figures combined would represent at the very least a direct investment of 270 million dollars, regardless of the new capital required in the application of the power.

In the review of activities by provinces which follows, it will be noted that Quebec took the lead in 1926 with 168,000 H.P., followed by British Columbia with 45,800 H.P., Manitoba with 43,200 H.P., Ontario with 5700 H.P., New Brunswick with 2600 H.P., and a small addition in Nova Scotia. The small addition in Ontario is largely attributable to the completion, in 1925, of a very large programme of construction which had extended over several years, and as a result a certain period of time must elapse before new projects commence to add their quota to the province's total.

BRITISH COLUMBIA.

The total increase of 45,860 H.P. in the installation in British Columbia was contributed by the West Kootenay Light and Power Company at Lower Bonnington Falls and the Powell River Company in its plant at Powell River. The West Kootenay Light and Power Company completed its 60,000 H.P. plant at Lower Bonnington Falls on the Kootenay River by the addition of the third unit of 20,000 H.P.

The Powell River Company completed an extensive programme of construction in connection with its pulp and paper mill and power plant at Powell River on the lower coast. In addition to replacing some of the old generating machinery with new, a new hydro-electric unit of 13,500 H.P. was installed, together with two 6180 H.P. units direct connected to pulp grinders, making in all an addition of 25,860 H.P.

The British Columbia Electric Railway Company completed the Alouette dam and spillway early in the year, and the resulting water storage proved of the greatest benefit during the low water season of 1926 in augmenting the supply at the Stave Falls power station. The construction of the 12,500 H.P. Alouette power station is being proceeded with, and is to be completed in 1927. In connection with the Bridge River project, the company carried on engineering investigations, and at the site of the power station on Seton Lake, extensive work was done in the preparation of camp buildings, tracks and material yards. At Jordar River on Vancouver Island the company raised its storage dam 8ft. and commenced the construction of a new flume of larger capacity than the one now in use.

ALBERTA.

In Alberta, although no new installations were added during the year, the Calgary Power Company extended its transmission system south a distance of 35 miles to serve the town of High River and a further extension of 12 miles to the town of Blackie. Power will be supplied from the company's plants on the Bow River at Seebe.

MANITOBA.

In Manitoba additions totalling 43,200 H.P. were made to the plants of the city of Winnipeg and the Manitoba Power Company. The city of Winnipeg added units 15 and 16 to its station at Point du Bois on the Winnipeg River. These units, which are each of a capacity of 7600 H.P., complete the installation of the Point du Bois station, which now has a capacity of 109,000 H.P. At the Great Falls plant of the Manitoba Power Company on the Winnipeg River, unit No. 3 of 28,000 H.P. capacity was added, bringing this station to a total of 84,000 H.P. A contract for the fourth unit, also of 28,000 H.P. capacity, has recently been let for installation in 1927. In addition to this new power installation, the company completed the structures appurtenant to the power station, which will permit of raising the forebay level to secure the full designed head. A steel tower 110,000-volt transmission line was also built from Great Falls to the mill of the Manitoba Paper Company, near Fort Alexander. This line will eventually form part of a new transmission line from the Great Falls plant to Winnipeg.

During the year the Manitoba Power Commission added to its system by the construction of a line from Portage la Prairie to High Bluff, a distance of 8¼ miles.

ONTARIO.

The new installation in Ontario during 1926 was comparatively small, amounting to 5746 H.P., but other works which are under construction or in early prospect will add considerably to the provincial total.

The Ontario Hydro-Electric Power Commission brought to completion at the close of 1925 its two large stations, the Queenston on the Niagara River with 550,000 H.P. and the Cameron Falls on the Nipigon River with 75,000 H.P. The Queenston station is now fully loaded, and for the further supply of the Niagara system the Commission has entered into a contract with the Gatineau Power Company for a block of from 230,000 H.P. to 260,000 H.P., delivery to commence in 1928. This power will be supplied from stations now under construction on the Gatineau River in the Province of Quebec, and the energy will be carried over a high-tension transmission line from the plants direct to Toronto. Surveys for the line are practically completed and construction will commence during 1927. On the Nipigon River the Commission commenced the construction of a new plant of 54,000 H.P. capacity at Alexander Landing, a short distance below the Cameron Falls station. Power from this new station will feed the Thunder Bay system and supply the growing market in the Port Arthur and Fort William district. In the Georgian Bay system the Commission completed the construction of a plant of 1550 H.P. capacity at Hanna Chute on the South Muskoka River, a short distance above and connected with the South Falls station.

In the Trent Valley the Quinte and Trent Valley Power Company completed two developments, one at Campbellford with 1100 H.P. and the second at Frankford with 2980 H.P., the power being used in those localities. In Northern Ontario the Abitibi Power and Paper Company completed the transmission line from its 48,000 H.P. plant at Island Falls on the Abitibi River to the mills at Iroquois Falls, and energy was delivered during the year.

In the extreme westerly part of the province the Keewatin Power Company completed its 17,000 H.P. development at the western outlet of the Lake of the Woods. In the same district the Backus Brooks Company commenced the construction of three developments on the Seine River, which will have a total capacity of 37,620 H.P. Two of these plants are well advanced, and all are to be completed during 1927. The power will be transmitted to Fort Frances for use in the pulp and paper mills at that place.

QUEBEC.

Water power activities in Quebec province continued on a large scale during 1926, and while the total of some 168,000 H.P. actually placed in operation fell short of that of the record year 1925, developments now under construction represent a future addition of more than 1,400,000 H.P., which indicates that progress has not slackened.

The hydro-electric activities of the Canadian International Paper Company in the Hull district are outstanding among the year's developments. The company started construction of a large electrically driven pulp and paper mill at Gatineau, Quebec, a short distance east of Hull, and through its subsidiary, the Gatineau Power Company, of three important hydro-electric developments on the Gatineau River, namely, 120,000 H.P. at Farmer's Rapids, 170,000 H.P. at Chelsea, and 240,000 H.P. at Paugan Falls. The first two plants are practically completed. This company is also taking an active part in the construction of the Baskatong storage reservoir on the Gatineau River under the direction of the Quebec Streams Commission.

In the Lake St. John district the Duke-Price Power Company added two units of 45,000 H.P. each to the Ile Maligne development on the Saguenay River. The present installation now totals 450,000 H.P., while the ultimate capacity is to be 540,000 H.P. Preliminary construction is being continued on the 800,000 H.P. development of the Aluminium Company of Canada at Chute-à-Caron on the Saguenay. A very notable feature of this district was the establishment of new industries, attracted by the remarkable power facilities offered by these most advantageous sites. The Aluminium Company is already operating its reduction works at the new town of Arvida, while a number of large pulp and paper mills and a 12,000,000-dollar electro-metallurgical plant are either under construction or projected. The construction of a 168,000-volt transmisson line is well under way to connect the Duke-Price Power plant with the Shawinigan system at Quebec City.

The Shawinigan Water and Power Company, through its subsidiary the North Shore Power Company, placed in operation a new development of 22,200 H.P. at St. Narcisse on the Batiscan River, replacing a 1600 H.P. installation reputed to be the first in the British Empire to supply energy over long-distance transmission. Other hydraulic installations placed in operation during the year included a 16,800 H.P. addition to the Kipawa plant of the Canadian International Paper Company; the addition of 800 H.P. to the Pont Rouge plant of the Donnacona Paper Company; a 2000 H.P. addition to the Electric Reduction Company's Plant at Buckingham; a new development of 515 H.P. on the Little Blanche River by the Papineauville Lumber Company; and a 72 H.P. plant at Mastai in connection with hospital work.

A 50-mile transmission line was completed from the Quinze power plant of the Canada Northern Power Company to supply the Rouyn mining field of Northern Quebec. A fairly extensive rural electric supply system was also completed on the Island of Orleans by the Montmorency Electric Company, the energy being secured from the Quebec Power Company.

In the Laurentian district north of Montreal, the Quebec Southern Power Corporation acquired the St. Jerome municipal plant, and is increasing the installation of its Rawdon plant from 300 H.P. to 2500 H.P.; the ultimate installation to be 7500 H.P. The corporation also added 100 miles of transmission lines to its system, which now totals 270 miles.

The Quebec Streams Commission continued its beneficial work which so enhances and encourages water power development throughout the province. The Commission now has extensive storage reservoirs in operation on the St. Maurice and the St. François rivers, Kenogami Lake, Ste. Anne-de-Beaupre and Mitis rivers, all of which were reported as being filled to capacity at the end of the year, the various plants affected being assured of an ample supply of water during the winter. The Commission has under its supervision the construction of the Baskatong reservoir on the Gatineau River, expected to be completed before the end of the present winter season; this includes Baskatong Lake and is to have a capacity of 94 thousand million cu. ft. to regulate the flow to 8000 cu. ft. per second. The existing storage system on the North River comprising three lakes was also recently taken over by the Commission, with the intention of improving the same in the near future. Further studies were made of the Mekinac storage on the lower St. Maurice, including additional borings, and it has now been decided to proceed with construction next spring at a cost of some 600,000 dollars. Other work includes storage surveys on the Batiscan River basin; a summary investigation of the Megiscan watershed for power and storage; a power site investigation on Rimouski River; and a storage reservoir survey on Sud River.

NEW BRUNSWICK.

The net increase of 2600 H.P. in the total installation in New Brunswick was accounted for in the plant of the Maine and New Brunswick Electrical Power Company at Aroostook Falls on the Aroostook River. It was occasioned by the replacement of a unit in the plant by one of larger capacity.

Of outstanding importance was the initiation of work at Grand Falls on the St. John River. At this site, which is the largest in the Maritime Provinces, actual development was commenced during the month of August by the St. John River Power Company. The scheme calls for an initial installation of 60,000 H.P. in three units of 20,000 H.P. each and involves the erection of a dam just above the falls, a tunnel through the rock under the town and a power-house in the lower basin which will operate under a head of 130ft.

The New Brunswick Electric Power Commission has built a new concrete dam at Loch Alva in connection with its Musquash development. In connection also with the Musquash system a transmission line was built from Moncton to Shediac, and another line of 35 miles is about to be built to Blacks Harbour. The Commission is at present carrying out an investigation of the power site known as Meductic Falls on the St. John River, about 40 miles above Fredericton.

NOVA SCOTIA.

In Nova Scotia the Nova Scotia Power Commission added a unit of 300 H.P. to its Musharnush development, and is negotiating with the town of Mahone to take over the town's plant. The Commission is building two new storage dams on the East River Sheet Harbour, and is co-operating with the Pictou County Board in the construction of a transmission line from Stellarton to serve the communities of Eureka and Hopewell. On Mulgrave Brook a small plant of 75 H.P. was put into operation to serve the needs of the town of Mulgrave.

Prospective developments in the province include the Sandy Lake stage of the St. Margaret's Bay development for the Nova Scotia Power Commission to meet the growing load in Halifax; a development on the Medway River by the Commission for the initial supply of about 2500 H.P. to the Scott Paper Company for a ground wood mill; a development of 3000 H.P. at Avon River Falls for the Avon River Power Company; and a further development on the West Branch of the Tusket River to supply the town of Yarmouth. Investigations have also been made of the power possibilities of the Gaspereau River, which will yield some 9000 H.P. and the St. Croix River which has a capacity of from 4000 to 5000 continuous H.P.

Altogether the activities for the year 1926 were on a scale larger than any yet recorded throughout the Dominion, and as new hydro-electric development inevitably results in the expansion of industry there is every indication of industrial progress during the coming years.

The Newcomen Society.

ON Tuesday evening, February 22nd, the Newcomen Society met at the Institution of Mechanical Engineers and listened to two extremely interesting papers written by French members, one by Messrs. Seguin and Achard, which we reprint below, and the other entitled "The First British Locomotives of the St. Etienne-Lyon Railway," by M. Achard, which provides some clue to the mystery which has surrounded these engines. The paper was accompanied by two admirable drawings recently discovered in the archives of the Compagnie des Chemins de Fer de Paris à Lyon et a la Méditerrande in the course of searches undertaken by the permission of M. Vallantin. They are not original drawings, but sun prints made in 1889 from tracings taken from the originals. Although not contemporary documents, they have great value, owing to the fact that their origin is authenticated by a note written on them by M. Augustin Seguin, son of Marc Seguin, and because the originals were made in the office of the Société des Chantiers de la Buire à Lyon, of which M. A. Seguin was the director. On one of the drawings it is stated that it is a copy of a drawing found in the papers of Marc Seguin, which was used for the construction of the first locomotive without tubular boiler, and that it was the first engine of the St. Etienne and Lyons Railway. On the other drawing the statement is made that it shows the first British locomotive introduced into France in 1827 and used as a model for the St. Etienne-Lyons Railway engine without tubular boiler. This statement appears to be erroneous. The drawing shows an egg-ended boiler with a pair of vertical cylinders at the extreme end driving grasshopper beams with connecting-rod to one pair of driving wheels. The two axles are coupled by a train of gears. The other engine has a vertical cylinder at mid-length on each side driving a long crosshead above. Connecting-rods descend to both driving wheels, which are furthermore coupled by rods.

BRITISH RAILWAYS OF 1825 AS SEEN BY MARC SEGUIN.

BY FERDINAND ACHARD AND LAURENT SEGUIN.

IN the course of researches about the first British locomotives ordered for the St. Etienne-Lyons Railway, it was thought that some valuable information might be found in the contemporary papers of the celebrated French engineer, Marc Seguin, and accordingly they were carefully studied. These papers are still in the hands of his descendants at his family seat of Varagnes, near Annonay. They comprise, *inter alia*, some large note-books which, while forming a kind of diary, represent at the same time a collection of technical notes to which Seguin could refer when required. In the twelve first books there is no mention of railways, but the book No. 13 (1825–26) gives most interesting details of the British railways then in operation.

It is the purpose of the present paper to give a full account of Seguin's statements on this subject. They furnish, as will be seen, a valuable contribution to the history of the locomotive, and clear up one point at least which has hitherto remained in doubt, viz., the construction of the four-cylinder locomotive Chitteprat, of the Stockton and Darlington Railway.

Marc Seguin was busy in 1825 organising a peculiar system of steam navigation on the Rhone, for which undertaking he had formed a company under the name

"Seguin, Dayme, Montgolfier & Cie." He was anxious to discuss with the engine makers Taylor and Martineau in London the construction of a steam engine for his boat, with a view to ordering one. Therefore, accompanied by his brother Paul and by Mr. de Montgolfier, he left for England. He took the opportunity of making an extended tour in England and Scotland in order to arrive at a better knowledge of the industrial and technical development in these countries. He always had been interested in these questions, and he had already formed the intention at this date (1825)—his papers give proof of it—to ask for the concession of the St. Etienne-Lyons Railway, which, he thought, would bring a good deal of traffic to his steam navigation enterprise on the Rhône.

He left Annonay on October 4th, 1825, at 9 a.m., and arrived at Lyons October 6 that the same hour. He took there the mail coach, which brought him to Paris on October 9th at 5 a.m. There he spent some weeks, and left on November 12th at 6.30 p.m., arriving at Arras on November 14th at 2 a.m., at St. Omer on November 15th, and at Calais on November 16th. He sailed on November 17th by the ss. Furie, 100ft. long, 15ft. beam, actuated by a 40 H.P. steam engine by Boulton, Watt and Co. Departing at 6.30 a.m., he landed at 10.45 a.m., the speed of the vessel being 3 m. per second† and of the paddle wheels 4·5 m. per second. In the evening of the same day Seguin arrived in London.

In the course of the succeeding days, he visited the works of Henry Maudslay, which, he wrote, "are noteworthy for the high perfection in the building of the engines, and by the small progress made by the system." He met Mr. Babbage and Mr. Brunel, as well as Messrs. Taylor and Martineau. He relates his discussions with the latter, from whom he finally ordered an iron boiler, and a three-cylinder steam engine, with 12in. by 33in. cylinders, with variable expansion and condensing pump, the whole, fully erected on board, for the price of £2500.

Incidentally, he gives in his book a sketch of "a steam engine as proposed by Montgolfier on December 4th, 1825," with a piston whose length is exactly half the length of the steam cylinder, with steam inlets at both ends and a steam outlet in the middle of the cylinder, the arrangement being that of the "Uniflow" steam engine of to-day. His idea, however, was only to detect the leakage of steam around the piston.

Marc Seguin left London on December 7th, 1825, at 8 a.m., for Leeds, where he arrived after twenty-four hours on the road. There he paid a visit to Mr. Farey, who at that time was particularly occupied with the study of the steam engine, by the aid of the Watt indicator. He then inspected the Middleton Colliery railway. He writes:

"We have seen the railway at Leeds, which is intended to bring the necessary coal to the town. It is about 3 miles long and is operated by a little steam engine of about 6 to 8 horse-power. It hauls twenty-four waggons loaded with 3½ tons each, with a velocity of 4ft. to 5ft. per second. The rails are of cast iron, 3ft. long, and rest on stones of about 50 cm. cube. The assembling piece of cast iron [*i.e.*, the chair] is fixed by means of holes made in the stone, and the rails fit one with another, end to end, and may be removed by hand. The railway has been in use for fifteen years, and is in a very bad state. It is operated by means of a rack cast on the outer face of one set of rails. Some years ago an accident occurred to the boiler, which exploded. It was caused by rivalry between the drivers, four of whom had a quarrel because some of them insisted upon doing a trial with the steam forced as much as possible. The others went away at the time of this experiment. The former fixed the safety valves, forced the fire, blew up the boiler, and were killed. This engine has been fully described by Tredgold."

On the following day, December 8th, Seguin arrived at Darlington, and visited the railway, which he describes with some detail. We shall return later on to his account of this interesting part of his journey. He left Darlington on December 11th at 1 p.m., arriving at Stockton the same day at 4 p.m., and left again the next day for Sunderland, and then for Newcastle, where he spent Wednesday, December 14th. He then started for Berwick. He remarked that on the Sunderland Railway "the iron horses are nearly the same as those at Darlington; these engines seem to have done but little service."

At Newcastle he paid a visit to George Stephenson, "civil engineer and builder." After a description of a new form of rails and chairs invented by Stephenson, he writes as follows:

"Mr. Stephenson for the underframes of his 'iron horses' makes the two axles movable, so that whatever the unevenness of the ground, the four wheels always bear evenly. He is now studying how to put two axles one above the other, with rollers to minimise the friction."

He states that Stephenson was then building steam engines on the Watt system. His steam cylinders are lined internally with copper, with metallic pistons. His prices for boat engines, complete with the paddle wheels and the necessary equipment, were as follows:—

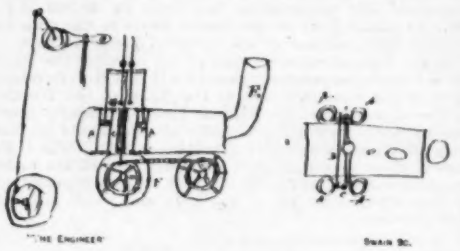
	£
3 horse-power	400
20 horse-power	1250
40 horse-power	1800

From Berwick Seguin continued his journey to Edinburgh, where he stayed from December 16th to 20th. He came back through Glasgow, Greenock—where he visited Dr. Brewster—Liverpool and London, where he spent the first week of the year 1826. Leaving London on January 8th for Dover and Boulogne, he was back in Paris on January 12th, 1826, at 6 p.m.

We will now return to the account given by Seguin of the Stockton and Darlington Railway, which, as already stated, forms the centre of interest of the whole report.

"Traffic is carried on," he writes, "by means of steam engines, and up till now there have been employed only two engines, hauling behind them sixteen to twenty wagons; but a third engine is now in course of construction. The weight of each wagon is 1000 kilos., and its load 2000 kilos. of coal. The power of the engine is 8 H.P. There is no rack, and it seems that the adhesion of the first carriage is sufficient to draw all the others. In the latest of these engines made there are four small cylinders of 6in. diameter and * inches stroke, into which steam is delivered under two atmospheres pressure, which steam is probably allowed to expand a little in the cylinders. This arrangement, of two cylinders on each side, with a connecting-rod between them, has been adopted without doubt to facilitate the communication of the motion of the piston to the crank below the cylinders. The piston-rods, instead of being guided by rollers, are guided by straight rods, which are fixed to the middle of the yoke or crosshead, and pass through holes similar to stuffing-boxes."

A reproduction of the rough sketch accompanying the above description is given in Fig. 1. Both sketch and description relate evidently to the locomotive Chittaprat,



built by Robert Wilson, of Forth Bank, Newcastle-upon-Tyne, the exact arrangement of which has hitherto been unknown. The Chittaprat, which was offered for sale by its builder at the price of £380, had been accepted for a month's trial on the Stockton and Darlington Railway, according to a decision of the sub-committee, dated November 25th, 1825.† The trial was not successful. It is very fortunate that the visit of Seguin took place precisely during the short period the engine was in use. Below is given the translation of the legend following the sketch reproduced in facsimile above:—

"A, cylinder 6in. diameter.

"B, a movable rod receiving a movement from a pin on the wheel. It actuates in a small cylinder C a piston, intended to distribute the steam, as in the system of Martineau.

"C, the above piston, including the steam passages opened and closed by gearing, whose detailed and enlarged drawing is in D.

"E, chimney having a diameter of at least 18in. and a height of about 10ft., limited by that of the bridges it has to pass under.

"F, the wheels. They are made of two concentric circles and the power is applied on the line of their junction."

It is difficult from the drawing and from the accompanying explanation to understand the exact mechanism of the valve gear, which seems to have been some sort of piston valve. It would appear, from the main sketch, that the piston C would have to be lifted by the two blocks mounted on the two vertical rods, coming into contact with the horizontal yoke; but this takes into account neither the play of the horizontal rod B nor the mechanism detailed on the left of the drawing. There remains therefore matter for further discussion.

The discussion on these two valuable historical papers was opened by Mr. J. G. H. Warren, who said that they crowned a series of discoveries made during the past five years which had given historians more accurate information on the first Stockton and Darlington Railway locomotives than had been published in England for nearly 100 years. It could now be said that the chain of evidence for the highly interesting experimental period 1825–1830 had been completed. It was curious that the final part of the evidence should be due to distinguished French engineers. Mr. Forward, in THE ENGINEER for December 14th, 1923, had already called attention to the difference between the evaporations obtained in England and in France with very similar boilers. The boilers used on the Stockton and Darlington locomotives seemed to have evaporated about 50 per cent. more water than those tested by Seguin. Perhaps that was on account of inferior coal, but at any rate it stimulated Seguin to develop and apply his multitubular locomotive boiler, on which he must have been working early in 1829 simultaneously with, or a few months previously to, Stephenson.

Mr. Forward, speaking of the Chittaprat engine, said that Seguin appeared to have been very much impressed with Taylor and Martineau's work, but there was very little known about it to-day. From engravings which existed it was known that they were makers of steam boilers of the horizontal type and there was such a similarity between the sketch of the Chittaprat engine and a plate which appeared in the *Quarterly Journal of Science* in 1826 of an engine of the horizontal type in which the cross heads were guided by rollers, made by Taylor and Martineau, that it was possible that Taylor and Martineau might have produced the designs for the Chittaprat locomotive even if they did not build it. As far as one could see, the valve gear of the Chittaprat was actuated by a rotating shaft across the top of the boiler, very much in the same way as with Nos. 2, 3, and 4 of the Stockton and Darlington engines, in which the cross shaft was driven by a pair of cranks from the driving axle and carried two excentrics for the valve gear. It was difficult, however, to see from the Chittaprat drawing how the motion was transmitted. Mr. L. Pendred thought Mr. Forward's idea of the valve gear was probably correct.

Mr. H. W. Dickinson said an endeavour had been made to find out more details of the firm of Taylor and Martineau. Beyond a reference to it in Rastrick's book and the diagram in the paper, nothing was known about it however. The works were in the City-road, London, and it was evident the two men were expert engineers. The name Martineau suggested French or Huguenot ancestry, and therefore it would be natural for Seguin to go to them and they quite likely got out a design for a locomotive.

After the meeting many of the members assembled at dinner and gave a very hearty welcome to Messrs. Seguin and Achard, members, of France, and to Dr. Matschoss, member, of Germany. In proposing the toast, Mr. Pendred referred to the international character of the Society.

† 6·75 m.p.h. = 5·9 knots.

* Blank in original.

† Warren. "A Century of Locomotive Building," page 116.

Books of Reference.

"THE Railway and Commercial Gazetteer of England, Scotland and Wales." Compiled from official sources. Eighteenth edition. 1927. London: McCorquodale and Co., Ltd., Cardington-street, N.W. 1. Price £1 1s.—This book is not only valuable to the railway companies, but also to the general public. So as to lessen the confusion felt by the ordinary individual, because of the new groupings of the railways, this edition gives the previous names of the companies in connection with each station mentioned. First issued over forty years ago, this volume has steadily increased in scope. Its pages now cover a wide area, and include no less than 46,000 towns, villages and hamlets. The book also contains a complete list—arranged in alphabetical order—of every railway station, town, village, hamlet, parish and place in Great Britain. It shows, too, the distance from London to each railway station and the distance by road from the station to the town, village, hamlet, parish and place, with the locality, population—from last census—line of rail, nearest railway station, distinguishing post offices, money order and telegraph offices, and the "through rate" routes for merchandise, passengers and parcels to, from or through London and all parts of the kingdom by the various railways. For the production of this, the eighteenth edition, the sections on "Railway Information," "Conveyance Group," "Population from Last Census," and "Postal Intelligence" have been thoroughly revised and corrected to present date, and every effort has evidently been put forward to make the work as complete as possible.

"THE Directory of Shipowners, Shipbuilders and Marine Engineers," 1927, which is compiled under the direction of the editor of *Shipbuilding and Shipping Record* and published by the Directory Publishing Company, Ltd., 33, Tothill-street, Westminster, S.W. 1, price 20s., appears this year in its twenty-fifth edition. Although some additions have been made, the size of the book has been kept conveniently small for desk work or for use when travelling. In the first section information is given concerning the Admiralty and other Government Departments, also the various Classification Societies, both at home and abroad. The second section, which deals with Shipowners, occupies 460 pages, after which there is a section of 108 pages giving particulars of Shipbuilders, Ship Repairers and Marine Engine Builders. Lists of Consulting Marine Engineers and Naval Architects, also Trade and Technical Organisations, are included. There is a very complete system of indexes, to which, we note, there has been added in the new edition an index to telegraphic addresses.

"THE *Motor Ship* Reference Book," 1927, appears this year in its third edition. It is compiled by the staff of the *Motor Ship* and is published by the Temple Press, Ltd., 7–15, Rosebery-avenue, E.C. 1, at a price of 5s. 6d., including postage. In the new edition of this reference volume technical particulars have been added of many new types of marine oil engines which came forward during 1926, and this section of the book may now be looked upon as being representative of almost all types of motor ship propelling and auxiliary machinery. A useful feature is a tabulated list of all motor vessels constructed during 1926, which, together with the particulars of motor ships built up to that date and those now on order, gives information on all motor vessels afloat and under construction. Much has been added to the statistical sections of the book, and in that section dealing with fuel and lubricating oils a list of 200 motor ship bunkering stations is given. The arrangement of auxiliary machinery is illustrated by a series of typical engine-room plans, while the book closes with a chapter on motor ship development in the year which has just ended.

WHITWORTH SCHOLARSHIPS, 1928.

THE Board of Education will offer for competition in 1928 the following scholarships on the Foundation of Sir Joseph Whitworth, to be awarded on the result of an examination to be held in or about the month of May of that year:—Six Whitworth Scholarships of an annual value of £125, which may be increased in special cases if the Board thinks fit, tenable for three years; and two Whitworth Senior Scholarships of an annual value of £250, tenable for two years.

The regulations governing these Scholarships may be obtained at H.M. Stationery Office or through any bookseller, price 2d., but we may say here that each candidate must be a British subject; he must have been engaged in handicraft—drawing-office work is not regarded as a handicraft—in a mechanical engineering workshop during ordinary working hours for periods amounting to at least thirty calendar months at some time before May 1st of the year in which he competes; and, for the Whitworth Scholarships, he must not have completed the twenty-second year of his age on May 1st next—*i.e.*, he must have been born on or after May 2nd, 1906. For these scholarships papers will be set in the following subjects:—(1) Machine construction and drawing or Naval architecture; (2) Mathematics (two papers); (3) Applied mechanics (two papers), including analytical mechanics, strength of materials, structures, machines and hydraulics; and (4) Heat engines or electrical engineering.

For the Whitworth Senior Scholarships the candidate must not have completed the twenty-sixth year of his age on May 1st next—*i.e.*, he must have been born on or after May 2nd, 1902—but a candidate who served with H.M. Forces during the war may deduct from his age a period equivalent in length to such service. Papers will be set in the following subjects:—(1) Construction and design of machinery or naval architecture; (2) Mathematics (two papers); (3) Mechanics; (4) Heat engines; (5) Strength of materials and structures; (6) Theory of machines, or hydraulics and hydraulic machinery, or electrical engineering; and (7) Engineering graphics.

Stability of Large Power Systems.

A PAPER dealing with a subject of considerable importance at the present time namely, the stability of large power systems, was read by Mr. F. H. Clough, before the Institution of Electrical Engineers on Thursday, February 17th. The stability of a system, the author points out, may be defined as its ability to respond to the power demands for which it is designed, and the stability limit is usually reached when the power which can be transmitted over a line or can be obtained from an alternator is a maxmium. As stability and voltage regulation are very closely associated, stability may also be expressed as ability to maintain voltage under the varying conditions of load for which a system, circuit or machine is designed. Generally speaking, transmission and distribution systems in this country are comparatively short and have been arranged to give reasonably good voltage regulation, so that lack of stability has not been troublesome; but in America and elsewhere, where power is transmitted over long distances, stabilty is becoming a subject of careful investigation. Although transmission and distribution circuits in this country are usually sufficiently stable, we are probably nearer to the instability point on large synchronous machines than is generally realised.

In order to show more clearly what is meant by stability of a circuit, some diagrams are given in the paper. In Fig. 1 it is assumed that a sub-station or distribution point is fed over a line containing considerable reactance, the power factor of the load at the sub-station being assumed to be 0·8, and the reactance of the feeder 100 per cent., *i.e.*, the reactance is equal to the impedance of the load under full-load conditions. In order to give normal voltage at the sub-station at full load, the voltage at the supply point must be 79 per cent. higher than at the sub-station. If the voltage at the supply point remains constant at this value of 179, and if the load is varied in magnitude, but always has a power factor of 0·8, then the sub-station voltage will vary according to the curve A B C, where the voltage is given in relation to the current flowing. By plotting the product of current and voltage corresponding to it, a power curve D B C is obtained, from which it will be noted that this power curve attains maximum value under normal full load conditions. The power factor at the sending end would be 0·446 and a machine of 179 kilovolt-ampères would be required to give 100 kilovolt-ampères at the sub-station.

On the assumption made of normal voltage at the sub-

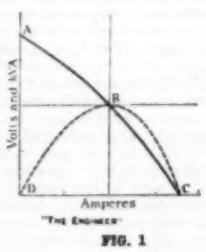


FIG. 1

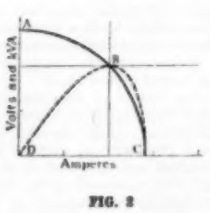


FIG. 2

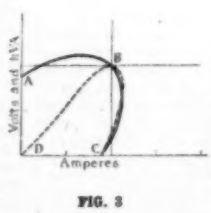


FIG. 3

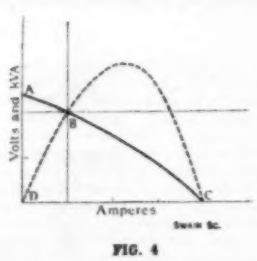


FIG. 4

station at full load, the voltage at the sending end will depend on the power factor of the load. For unity power factor 141 volts would be necessary, and for 0·8 leading power factor 89 volts. In all cases, however, the maximum power limit would have the same value, and would occur at full load. Fig. 2 gives the curves for unity power factor, and Fig. 3 for 0·8 leading power factor. For a given assumed value of the sending end voltage, the power limit can be raised by raising the power factor of the load. If the load at the sub-station consists of induction motors, it will readily be seen that such a system would be unstable, for if the motors are called upon to supply additional load they will respond by taking more current with a resultant fall in voltage. The reduced voltage will require more current and a further drop in voltage, so that the voltage will rapidly fall off and the motors will come to a standstill. The system is therefore unstable. If synchronous motors were installed instead of induction motors, the system would be equally unstable if the power factor remained at its original value, but synchronous motors could be made to supply leading current to change the power factor, and the power limit could be raised. Instability does not necessarily occur at the point of maximum power. If the load consisted of lamps, heating devices, or lightly loaded transformers, then the current would vary with the voltage, and it would be possible for the system to be stable, although the power limit had already been passed.

In certain cases instability is a very desirable characteristic of a circuit. An inductive circuit is, for example, very suitable for supplying a furnace, for with varying resistance the load remains practically constant, and by working with still higher currents, *i.e.*, well beyond the power stability point, conditions can be obtained to give approximately constant current—a condition suitable for welding. Speaking generally, the natural limit for power stability of a circuit is reached when the external reactance is about 100 per cent., or, in other words, in the case of a transmission line the maximum power will be transmitted when the impedance of the load is approximately equal to the reactance of the transmission line.

When the reactance of a line is high, a large amount of reactive kilovolt-ampères is required to send the current over it, and if this reactive kilovolt-ampère is supplied by the generators at the sending end, these machines will be unduly large, and will operate at low power factor, and the voltage at the sending end will be very high. It is preferable to subdivide the total reactive kilovolt-ampères by placing something at the receiving end in the form of synchronous condensers, as by so doing the power factor of the line can be raised, the voltage at the receiving end reduced, and held approximately constant.

It was also shown that the stability of the machines can be used to increase the stability of the system. In certain cases synchronous condensers are connected to intermediate points along the line, as this makes a long line equivalent to several short ones in series. The presence of considerable capacity currents in high-voltage lines helps to improve the power factor and to reduce the amount of kilovolt-ampères supplied by the synchronous machines. If the capacity current is large enough to have the same ratio to the power current as the reactive voltage has to power voltage, then both voltage and current vectors will rotate through the same angle in any given length of line, and if in phase at the sending end will also be in phase at the receiving end. This arrangement will give unity power factor transmission, the minimum drop in the line and the minimum amount of synchronous machinery, but if the reactance is high, the line is liable to be unstable, the machines at the two ends will have a considerable difference in phase, and will be liable to fall out of step. Where large powers have to be transmitted over long distances it would seem desirable to split up the line into a series of shorter lines, or to generate and transmit at low frequency and to convert to normal frequency by means of motor generator sets at the receiving end. With low frequency the reactance could be made low enough to give the necessary stability, and as the voltage could be varied for varying loads, the maximum use could be made of the capacity current to give unity power factor, and reduce the size of the synchronous machines.

The most usual type of transmission line in this country at the present time is one about 25 miles long, carrying a load of 10,000 kilovolt-ampères at a pressure of 33,000 volts, but probably in the future there will be 75-mile lines, carrying 50,000 kilovolt-ampères at 132,000 volts. At 50 cycles per second the reactance of both these lines is 30 to 35 per cent. including step-up and step-down transformers. The diagram for the receiving end when the plant is delivering a load at 0·8 power factor is given in Fig. 4, the line being stable up to a considerable overload. In the higher voltage line there would be a capacity current approximately equal to the magnetising current of the transformers. Reverting again to Fig. 1, where a circuit of 100 per cent. reactance is considered and capacity current is neglected, if the voltage at the supply end could be varied so as to keep the voltage at the receiving end constant under all conditions of load, the power limit and stability would be raised indefinitely. Within limits, the practice of raising the power factor by means of leading currents from synchronous motors at the receiving end also increases the stability. This can be considered as making the circuit artificially stable and in some cases artificial stability is of greatest importance.

The author also deals with short circuits and transient stability of alternators, internal reserve of excitation of synchronous machines, artificial stability of alternators, stability of exciters, types of electric power systems, feeders and transmission lines, and their voltage control. The conclusions arrived at are that synchronous machines can be made sufficiently stable for all the usual purposes of power supply and that power limit and voltage regulation of transmission circuits depend on their series reactance.

South African Engineering Notes.

Engineering in 1926.

The year 1926 will be memorable in the engineering sphere because it was in the latter part of that year that the production of pig iron was commenced, and on a fairly large scale, at Newcastle, Natal, thereby providing the foundations of a real engineering industry. The blast-furnace there has already produced many thousands of tons of pig iron of excellent quality, which has been highly praised by all who have used it. The furnace has a capacity of from a thousand to twelve hundred tons a week, and it is worthy of note that, despite the outlet furnished by the open-hearth furnaces of the Union Steel Corporation at Vereeniging, the disposal of the make has been by no means easy. In fact, so little is the country, as yet, an industrial one that one blast-furnace appears more than capable of coping with its demands for pig iron. The steel output at Vereeniging is, however, likely to increase appreciably. Bolts and nuts are being made, a big wireworks is close to the producing stage, and a works for making tubes and pipes will be proceeded with as soon as the provisional agreement come to between Stewarts and Lloyds, Ltd., and the Union Steel Corporation, to which reference is made in the next paragraph, has been duly ratified. The wire works will be able to supply the South African demand for fencing wire, baling wire, reinforcing wires and rods for concrete, and the various qualities of special wire required in the making of wire ropes. Most of the mining industry's wire ropes are already made up at a big works near Johannesburg, but hitherto only imported wire has been employed for the purpose. It is interesting to note that overseas manufacturers are considering the possibility of establishing works in the Union, now that pig iron and steel are native products.

The year 1926 witnessed the opening of the whole of the electrified section of the Natal railway system and, in an engineering sense, almost unqualified success has been achieved. This first effort in electrification has undoubtedly been a costly business, and it will require a couple of years of operation to prove that the undertaking is an economic success. One weak point has already been disclosed; the very great tractive effort of the three-unit engines has tried the permanent way severely, and developed rather serious defects. The obvious remedy is being adopted; new rails of heavier section and of the best quality steel are being used. The electric locomotives are moving the traffic in a most admirable manner, and, to enable them to continue doing so, rails equal to the stresses they have to undergo must be laid down.

Much was done in the field of electric power supply. The first three sets, each of 20,000 kilowatts at 3000 r.p.m., were commissioned at Witbank, and are turning out what is claimed to be the cheapest electricity from steam in the world. The cheapness of this power promises to draw electro-thermal and electro-chemical industries to the neighbourhood, the first on the scene being the Rand Carbide Company. A 30,000-kilowatt station is well under way at Salt River, near Cape Town, and further plant has been ordered for the municipal power station, Cape Town, which is to be linked up with the Salt River station, so that the total output available within a year or so will be close to 60,000 kilowatts. The Cape suburban system, the electrification of which is now in hand, will make a big demand upon these stations, but, in addition, a wide-flung distribution system is being built up to link up all possible consumers of note within 50 miles of the stations, and the Cape promises shortly to be a really good example of an electrified zone. Meanwhile, much interest centres upon Durban, where the Electricity Supply Commission has made a start on the first big station undertaken by itself direct. The designed capacity of the station has already increased far beyond that originally contemplated, and the Congella power plant will be the first in the Union to embody pulverised coal firing.

Several of the largest towns of the Union have tackled in earnest domestic electricity problems, and remarkable progress in developing the electric home has been made in Cape Town and Durban. Finally, there is to-day a surprisingly small number of urban communities in the Union which have not at their disposal the amenities of electric light, and the number is rapidly growing less as new schemes are being formulated and adopted.

In other branches of engineering there is considerable progress and continued activity to report. Quite a number of new water undertakings have been completed or are under construction. Among the former may be mentioned the second 5,000,000-gallon equipment at Vereeniging, and big works at Pietermaritzburg, and East London; among the latter, Shongweni, Steenbras and Khami, for Durban, Cape Town and Bulawayo (Rhodesia) respectively. The use of reinforced concrete pipes for mains in South Africa is no longer an innovation, but seems likely to become standard practice, although the alternative of spinning concrete linings into metal pipes has been adopted at the Cape. Sewerage schemes are the things of the times in South Africa to-day, and their multiplication suggests that the country is emerging from the pioneer stage and settling down to develop on modern civilised lines.

The four main harbours are all scenes of activity in extensions and improvements, important works being in progress at Port Elizabeth, East London and Table Bay in particular. Walvis Bay has also been greatly improved, while plans for new wharves are in train for Durban, where the chief activity of late has been in extending the coal-shipping facilities of the port. Though there has been a great deal of talk about good roads, so far there is very little real progress to report. The authorities concerned are making tentative experiments with machinery for grading and maintaining veld roads, but the possibilities of cheaply made roads of that type do not so far appear to have been fully appreciated.

The engineering workshops and foundries have had a fairly busy year and continue to turn out an ever-expanding variety of jobs and special articles for the needs of the mining industry in particular. Altogether, there is much real progress in evidence, and the outlook for engineering in South Africa is quite a bright one.

Steel Combine Formed.

A big development in the steel industry of South Africa is foreshadowed by the announcement that a provisional agreement has been entered into between the British firm of Stewarts and Lloyds, Ltd., and the Union Steel Corporation of South Africa for the formation of a new company to be called "Stewarts and Lloyds of South Africa, Ltd." This announcement has been confirmed by the heads of the Union Steel Corporation. The new company is to erect another factory at Vereeniging, where the Union Steel Corporation's big steel works is situated, and there tubes will be manufactured from steel supplied by the Union Corporation. As the manufacture of tubes is a specialised industry requiring up-to-date plant and skilled men to carry out, it is probable that a sum up to a quarter of a million sterling will be spent on buildings, plant and equipment by the new company, which will take over the subsidiary company hitherto carried on here for twenty years, of Stewarts and Lloyds. This agreement marks an important stage in the history of the steel industry in South Africa, and an important stage in the development of the little town of Vereeniging, which bids fair to become the Sheffield of the country. The Union Steel Corporation only last year acquired the Newcastle Iron and Steel Works, which were valued at £215,571.

Two Huge Locomotives.

The Railway Board has accepted the tender of Messrs. Henschel and Son, of Cassel, Germany, for two experimental locomotives of great size and hauling power. The total cost will be £24,000. The two engines will be the largest in use on the South African Railway system. Orders for locomotive boilers to the value of £12,500 have also been placed with a German firm. Practically all orders for locomotives and steel rails are now going to Germany and the United States of America, and this has been the state of things for over twelve months, and looks like continuing.

Table Mountain Cableway.

A start has been made with the construction of the aerial cableway which is to convey passengers to the top of Table Mountain, 3582ft. above the waters of Table Bay. A new road with a fairly easy gradient is being constructed to lead to the site of the lower station, which will be situated at a point along the contour path 1000ft.

above sea level. The lower station will have an open terrace running about 8ft. above the level of the approach road, and from it passengers will enter a large waiting room. Ticket office and turnstile will then be passed, after which a flight of stairs will lead to a platform, where the aerial cars will be moored. Electric power from the municipal supply will provide the means of operation, and in the short space of six minutes passengers will be raised 2500ft. from the starting point. The cars are designed to carry nineteen passengers and a conductor, and they are capable of dealing with 150 passengers an hour. Two cars will be used, one ascending and the other descending at the same time. All the equipment and machinery is being supplied by the firm of Adolf Bleichert and Co., Leipzig. The Table Mountain Aerial Cableway Company, Ltd., made several inquiries with British firms, but, as far as they could ascertain, there was no British firm with the necessary experience in the erection of passenger aerial ropeways. The German firm is sending out its chief engineer to supervise the erection under Mr. Stromsoe, the engineer in charge of and the main originator of the scheme.

BORBERA VALLEY HYDRO-ELECTRIC INSTALLATION.

THE project for the construction of important hydro-electric works in the Val Borbera, recently approved by the Italian Ministry of Communications, will rank among the largest enterprises of its kind in Upper Italy. The main object is to supply energy, estimated at 80,000,000 kilowatt-hours per annum, to be employed exclusively for the electrification of a number of lines forming—or to form—part of the Italian State Railway system.

The main construction work will include the building of a large artificial lake or reservoir with a catchment area of 5·5 square kilometres, and a storage capacity of about 160,000,000 cubic metres. The carrying out of these works has been rendered necessary by reason of the uneven supply of water, which varies between a minimum of 0·5 cubic metres per second, during the dry season, and 500 cubic metres or more in the full rainy season. The lake will enable the rate to be regulated. The formation of this catchment area will necessitate the appropriation or destruction, by submersion, of a considerable cultivated or inhabited territory, including three communes with a total population of 1500.

There will be two power stations known as the Persi and the Pian-della-Botte respectively. From the reservoir to the first power station—Persi—where the fall will be 104 m., the water will enter a tunnel 4 kiloms. in length, under pressure, with a carrying capacity of 30 cubic metres per second. At the station three units, of 9000 kilowatts each, will be installed. By means of a canal, 2 kiloms. in length, the water will be conducted from this station into, and will then be regulated from, a reservoir which will be constructed on the Rio Gravaglia, and which will have a storage capacity of 600,000 cubic metres. From that reservoir the impounded water will pass through a tunnel of 8 kiloms. in length to the second station—Pian-della-Botte—where there will be a fall of 110 m., and where the plant installed will have one-half the capacity of that established at Persi, that is to say, three units each of 4500 kilowatts.

The Val Borbera hydraulic works have a double purpose to perform, as, in addition to supplying energy for railway electrification, the surplus water will be devoted to the irrigation of a wide zone, approximately 25,000 hectares, of good agricultural land situated in the plains of Tortona, Novi and Alessandria. The water will be taken in a direct line to the river Scrivia, where it will be stored by means of a barrage constructed in the bed of the river; thence it will be conveyed by two main canals and distributed through a system of smaller channels. The construction work of the Val Borbera stations will be carried out by the Società Elettrica Interregionale Cisalpina, of Milan, which was constituted in March, 1919, as an affiliated concern of the Società Generale Italiana Edison di Elettricità.

THE INSTITUTION OF MINING AND METALLURGY.—The annual dinner of the Institution of Mining and Metallurgy will be held at the Hotel Victoria (Edward VII. Rooms) on Wednesday, April 6th next, at which the Right Hon. L. C. M. S. Amery, Secretary of State for the Dominions and Colonies, will be the principal guest. The annual general meeting of the Institution will be held on Thursday, April 21st, at which Mr. R. E. Palmer will succeed Sir Thomas H. Holland as president.

ROYAL SCHOLARSHIPS AND STUDENTSHIPS IN SCIENCE.—The Board of Education has recently issued the syllabus for the examination to be held in April and May, 1928, for Royal Scholarships and Free Studentships in Science, tenable at the Imperial College of Science and Technology, London. These awards are open to British subjects of either sex, without age limit, and cover fees and, subject to evidence of financial need, a Royal Scholarship may include such maintenance allowance not exceeding £80 a year as the Board think fit. The syllabus and full details of these scholarships and studentships can be obtained from the Stationery Office or through any bookseller.

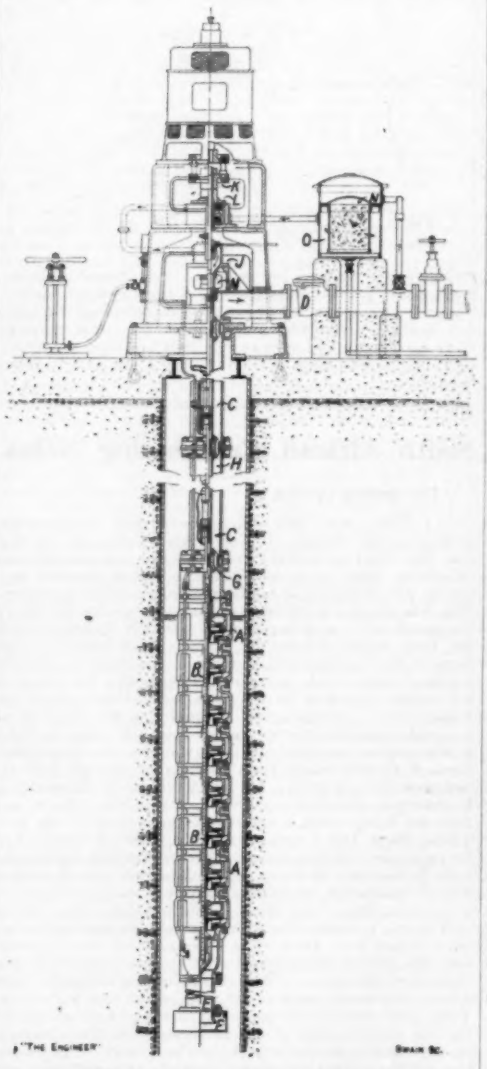
VICKERS GROUP AMATEUR OPERATIC SOCIETY.—On the evenings of Thursday, Friday and Saturday of last week the Vickers Group Amateur Operatic Society gave performances of "Miss Hook of Holland" at the New Scala Theatre. We were invited to be present on the first occasion, and we had the pleasure of witnessing a wonderfully good presentation of this popular light opera. We have on previous occasions borne testimony to the good work done by the Vickers Group Operatic Society; its latest effort served to enhance the high opinion we had already formed of it. The opera went excellently. The acting was, naturally, not quite even throughout the caste, but it may be truly said that there was not a single really bad part, and there were some that were quite first class. In some cases, too, the acting improved as the play went on; those who had been a trifle weak at the start came into their own as time progressed. We have not space to venture upon individual criticisms, but it can at least be said that the acting and facial expression of one of the characters was strongly reminiscent of George Graves. At any rate, that comedian need not have been ashamed of them. The chorus was excellent. It was well dressed, well drilled, and it sang in tune and in time. It could hardly have been better. The orchestra, too, which is another of the Vickers Group institutions, played extremely well. Altogether it was a most successful "first night."

DEEP WELL TURBINE PUMP

THE PULSOMETER ENGINEERING COMPANY, LTD., READING, ENGINEERS

A Deep Well Turbine Pump.

A MULTI-STAGE motor-driven turbine pump has recently been installed by the Pulsometer Engineering Company, Ltd., Reading, at a brewery in the Manchester district. The pump is designed to deliver 20,000 gallons of water per hour against a total head from all causes of 300ft. when running at 1440 revolutions per minute and absorbing



SECTION THROUGH WELL AND PUMP

60 brake horse-power. It is direct coupled to a 75 brake horse-power, vertical spindle shunt-wound motor which is supplied with direct current at 440 volts, and is arranged for working at a depth of 230ft. below the surface, the water being delivered into a storage tank 50ft. above the ground. When the pump is stopped the standing water in the bore-hole rises to approximately 70ft. from the surface, so that the pump is always self primed for starting.

As will be seen from the accompanying drawing, the pump consists of a series of eight casings A bolted together, each casing containing an impeller B, all being mounted on a common shaft. The water is drawn into the first casing at the bottom, is discharged into the next casing above, which in turn delivers it into the third casing, and so on throughout the whole series. The water leaves the last or upper casing and passes into a vertical discharge column C, from which it is forced to the surface by way of the branch and back-pressure valve D. The pump casings are made of cast iron and are fitted with renewable wearing rings and bushes made of gun-metal where they come in contact with the impellers and shaft. The bottom casing is furnished with a suction pipe E, on the lower end of which is provided a strainer F. The impellers, which are of gun-metal, are machined all over, carefully balanced and keyed to the shaft. The vertical driving shaft passes up the centre of the discharge pipe or column, the latter being built up of steel piping in 7½ft. lengths with flanged and bolted joints. At each of these joints there is a bearing G for the vertical shaft. The flanges of the column are threaded and screwed on to the pipe, which is expanded and then riveted over. In order to secure absolute parallelism each length of pipe with its two flanges was placed in a lathe and the flanges were faced and counter-bored to receive the bearing spider. At its upper end the column is bolted to the head piece which rests on the bed-plate at the surface, and above that, again, the electric motor is mounted. The vertical shaft H is made of mild steel and it runs in bronze sleeve bearings. The sections are coupled together by means of screwed sockets, while the nuts of the shaft are butted together.

The bearing shells are of cast iron lined with lignum vitæ strips, which form the bearing surface, and the bush is supported by ribs from the circular rim which fits in a recess of the flanges of the column. At its upper end the shaft passes through a stuffing-box J in the pump head and it is secured to a coupling K which rests on a thrust bearing L to carry the weight of the revolving parts. The pump head is of cast iron and has a large flange which rests on a facing on the bed-plate, and the outlet branch is arranged on one side of it. An extension of the pump head carries the thrust bearing which is of the Michell type with a large oil reservoir and automatic circulation of the oil.

In order to prevent, as far as possible, any sand from the bore-hole reaching the bearings and shaft, a supply of clean water is laid on from the top of the bore-hole, the clean water being led down to the bearings by a steel pipe arranged on the outside of the shaft and secured by screwed sockets to the bearing spiders. A small amount of vertical play is allowed in the recess between the flanges of the suspension pipes. The pump spindle is really a tube, and the clean water is led down through it to the bearings and slipperings, the steel pipe at the top terminating in a gland with a series of hat-leather packing rings M. The water is taken from the discharge side of the pump and is passed through the filter N before use. The filter, which is shown in section, consists of a bucket strainer lined with towelling, and the bucket is filled with wood wool to catch the coarser grains of sand, while the towelling intercepts the finer grains. The lid of the filter is secured by swing bolts so that it can easily be opened to enable the strainer box to be lifted out for the renewal of the wood wool filtering material. The filter is also utilised as an oil cooler O, for which purpose a wrought iron coil is arranged in the body and connected with the oil reservoir of the Michell bearing.

The half-tone illustration shows the pump in course of erection at the makers' works.

ROYAL AGRICULTURAL SOCIETY.—The annual Show of the Royal Agricultural Society of England will this year be held at Monmouth from July 5th to 9th next inclusive. The total value of the prizes offered will be £14,701, of which £1418 will be contributed by the Newport Local Committee and £3242 by various Breed Societies. Of the remainder, £1873 will come from other sources, while the rest will be found by the Society. Full particulars may be obtained from the secretary at 16, Bedford-square, London, W.C. 1, and intending exhibitors of implements, &c., are advised to make early application for the necessary entry forms.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Canal Improvement—Probable Abandonment.

MANY Midland engineers and manufacturers will learn with regret that a recommendation for the abandonment of the project for the linking up of Birmingham with the sea by the improvement of existing waterways will be made to the Birmingham City Council at its next meeting. After long and careful consideration of the report presented to the General Purposes Committee by the Special Canals Committee, it has been resolved to recommend that the whole question of acquiring and developing, or merely acquiring existing canal routes, be not proceeded with. The Special Committee, in its report, dealt at considerable length with the various investigations which had been undertaken since its appointment in June, 1923. Several routes for linking up Birmingham with the sea were considered, but attention was eventually concentrated on the "Mersey" and "Severn" schemes. The final conclusion of the sub-committee was that, while convinced of the eventual desirability of the application of the 100-ton standard to the "Severn" route, it was of the opinion that the adoption of that standard would be undesirable until circumstances were more favourable, but that developments of that character should be undertaken gradually as conditions improve. At the present time extensive improvements from methods of co-ordination alone could be secured. Accordingly, the Committee said it would be inadvisable to launch such a scheme under existing financial and other conditions, but at the same time it was unanimously recommended that Birmingham, together with other local authorities concerned, should "maintain" the existing route to the sea *viâ* Worcester, Gloucester and Bristol, "as a free waterway," free in this context meaning, of course, not toll-free but free from the control of competing transport interests. The General Purposes Committee, however, is evidently dubious with regard to the future, and its recommendation is that neither the improved project nor the maintenance scheme be proceeded with. And if, as is expected, the City Council takes this advice, the effect will be that the whole idea of the improvement of water communications between Birmingham and the sea will have to be regarded as abandoned. So impotent a conclusion to a prolonged inquiry undertaken with such high hopes is to be regretted. The inquiry, however, would appear to have established two facts of importance:—that a modern 100-ton canal, whether to Bristol or to Liverpool, could not be expected to pay its way; that Birmingham and Midland manufacturers are less anxious to see canal facilities improved than was generally supposed.

Need for Scientific Research.

Mr. David Lewis—Messrs. John Harper and Co., Willenhall—at a recent gathering of Midland Industrialists, after stating that he believed that industrially this country would emerge successfully from the period of depression through which it had been passing during the last few years, entered a plea for closer co-operation between science and industry. A tradition of quality for quality, such as was possessed by the iron and steel manufacturer of this country, was very desirable, but it could not be expected to last indefinitely without adaptation to meet the new conditions which arose. Lord Ednam also laid stress on the necessity for research work, particularly as regards the coal trade. If the coal industry were to survive, he said, it was essential that it should produce cheap fuel, because without it the other industries could not live, and upon them it was also mainly dependent for existence. To obtain cheap fuel it was necessary that there should be a greater concentration upon scientific research, experiment, and development. He was pleased to learn that a coal research laboratory had been opened at Birmingham University. That was very important, not only from the point of view of the colliery proprietors, but from that of the iron and steel manufacturers. In that district, for instance, they had not been sufficiently up to date with regard to fuel economy, and the saving of fuel costs generally, and greater attention and research were needed with regard to low temperature carbonisation, which was of great importance to the heavy industries of the country. After stating that Germany, Belgium, France and America were very much more up to date than this country in the matter of scientific research, and that they were experimenting all the time and finding out better processes, he expressed the opinion that the same thing would have to be done in this country if it were to succeed in the competition of those countries in the iron and steel trade.

The Midland Electricity Scheme.

Some details of the technical scheme of the West Midland Electricity Authority, which involves an expenditure of £3,500,000, have just been made known by Mr. S. T. Allen, the chief engineer and manager. £1,500,000 is to be spent in the purchase of generating stations, including Birchills extension; £400,000 on transmission mains; £300,000 on sub-station switchgear, &c.; £1,250,000 on the first section of the Ironbridge generating station; and £150,000 on the Ocker Hill extension.

Policy of Co-operation.

Sir William J. Larke, director of the National Federation of Iron and Steel Manufacturers, spoke at Birmingham recently of the development of the iron and steel industry within the Empire, and emphasised the importance of co-operation with the Dominions and Dependencies. The Empire already absorbed, he said, 50 per cent. of exports in iron and steel. The best thing for this country was that businesses of a similar kind in other parts of the Empire should be developed on the most economic lines. Such a development might seem the extension of competition; but it would enable the Dominions to absorb an increasing proportion of our industrial population as well as of industrial products.

Midland Colliery Agreement.

An agreement has at last been reached between the miners' officials and owners of the West Midland District, by which, if ratified, the men will work an eight-hour day, less twenty minutes for meals, until the end of March next. Wages will be 57 per cent. on the basic rates, and thereafter, until the end of June, not less than 47 per cent. on the basic rates. To any adult able-bodied day-work workman whose rate per shift, after adding the district percentage, is less than 6s. 2d., a subsistence wage will be added to that sum per shift, making it up to the minimum rate of 40 per cent. on the basic rates. The agreement will remain in force till June, 1931.

Market Situation.

The Midland iron and steel market is still dominated by the unsatisfactory fuel conditions. High production costs are having the effect of keeping up material prices, and, as a consequence, buying is being done in a very restricted manner. Producers of iron and steel are not likely to get relief in costs till the market initiative has passed from the seller of fuel to the buyer. Engineers and consumers of iron and steel will, in all probability, have to wait until then for any lowering of quotations. Meanwhile the market continues almost inactive, there being little desire on the part of either producer or consumer to transact business.

Raw Iron.

There has been no change during the past week in the situation in the raw iron department. Both producers and consumers maintain their recent attitude regarding prices, and business is on meagre lines. For foundry No. 3 sellers still quote £4 5s. for Derbyshire, and £4 2s. 6d. for Northamptonshire. Three months' contracts at half a-crown less would not be ignored, and it is possible that a more limited order on those terms would be accepted, though some furnacemen are stiffer in their attitude than others. With furnace coke difficult to secure and tending to increase in price, smelters are forced, they say, to maintain present selling rates. Many Midland foundrymen have still some foreign pig to receive on account of old contracts, and they are willing to run out all their reserves in the endeavour to force smelters to make price concessions. Forgemen have but slender resources, but the recent slight improvement in demand has fallen off, and the market is in a state of inactivity.

Manufactured Iron.

The finished iron department continues in an enfeebled state. True the marked bar mills are well employed, but they are working off arrears of orders, and little new business is coming along. Values remain unchanged at £14 10s. Lancashire makers, competing here, are endeavouring to meet the market by offering Crown bars at £11 15s. upwards. The Staffordshire make is quoted £12, but one or two firms are reported to have shaded this figure. Most of the common iron, such as is used in the nut and bolt trades, is imported, for the obvious reason that it is substantially cheaper than the native made iron. Belgian No. 3 bars could be bought this week at £6 2s. 6d. delivered in the Black Country.

Steel.

The most animated section of the market is that concerned with steel. Here there is pressure for deliveries, but new business is not being booked anything like so fast as the old is being worked off. Many of the big concerns have as many orders on hand as will ensure employment for months ahead however. A good inquiry is reported for structural steel and for shipbuilding requirements. The output from British works of billets has been greatly increased, but owing to the high price, compared with that of continental shippers, the demand is not brisk. Steel quotations generally are unchanged.

Blast-furnace Coke.

The stringency in blast-furnace coke becomes worse, and values, which have been steady at the high price of 20s. per ton, are now mounting higher. It appears there is now no furnace coke on offer at less than 21s. On 'Change in Birmingham to-day—Thursday—quotations had the very uncommon divergence of 5s., ranging from 21s. up to 26s. at ovens. Not only is the price high, but supplies are very precarious. Some Midland furnaces which have been blown in have only with difficulty been kept going. Foundry coke is now available in fairly large quantities at relatively easy rates for the grade required, quotations ranging from 30s. to 35s. on rail. There is an abundance of slack and small coals, and there has been an easing of prices in industrial sales of those grades.

Galvanised Sheets.

In the sheet department price weakness continues. Galvanised sheets have been further reduced to £15 5s. for 24-gauge, and a reduction of £1 has been declared on 30-gauge sheets, making the new price £20 15s. There is no perceptible improvement as yet in business.

Iron Pipes.

Cast iron pipe makers in Derbyshire have heavy order books and output is being gradually increased as pig iron becomes available. An encouraging feature is that the activity is not entirely dependent upon orders booked months ago, but there is a good flow of new business emanating from both home and overseas buyers.

Unemployment.

The recent improvement in the labour situation in the Midlands continues. Unemployment, as shown by the return issued by the Ministry of Labour, has decreased again this week, the total in the current return of wholly unemployed being 2974 fewer than that recorded in the previous statistics.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Ship Canal Developments.

GOOD progress is being achieved in connection with the Manchester Ship Canal improvement schemes. The directors' report points out that the first of the two reinforced concrete transit sheds on the north side of No. 9 dock is virtually completed, and that the second shed is well advanced. Satisfactory progress has also been made with the provision of road and railway facilities for the development of the company's extended dock estate at Stretford and Barton. The deepening of the Canal to 30ft. between Eastham, Ellesmere Port and Stanlow oil dock is on the point of completion, and the rock dredging required to provide the additional depth in the length of the Eastham approach canal between Eastham Ferry and Eastham locks has been carried out. Of the few undertakings in the country to benefit through the coal stoppage, the Ship Canal was one, largely because of the huge imports of foreign coal that poured into this area. Sea-borne traffic last year increased by well over 900,000 tons—from 5,622,000 tons in 1925 to 6,533,000 tons—and the previous year's record was thus easily exceeded, the net income at £962,000 also constituting a record, comparing as it did with £889,000 in 1925.

Industrial Results.

The annual reports of three Lancashire engineering firms issued during the past few days all disclose reduced profits as compared with 1925, and throw an interesting and practical sidelight on the fortunes of the engineering industry last year. In the case of Mather and Platt, Ltd., Manchester, who are textile, electrical and hydraulic engineers, the net profit in 1926 amounted to £251,636, compared with £260,885 in the previous year and £275,034 in 1924, and a tax-free dividend of 15 per cent. is being paid for the year, a rate which has been maintained during the past five years. The trading profit of the Vulcan Motor and Engineering Company, Ltd., Southport, in 1926 was £32,571, but the net profit after interest payments and the allocation of £3000 for income tax reserve, was £5324. In 1925 the trading profit was £37,414, leaving a net profit of £18,963 after the payment of interest. Reduced profits and reduced ordinary dividends are announced in the annual report of the National Gas Engine Company, Ltd., Ashton-under-Lyne. The balance of £27,466 compares with £39,147 a year ago, the ordinary shares receiving 2½ per cent. for the year against 4 per cent. in 1925.

Adding to Omnibus Fleet.

The Manchester Tramways Committee at a meeting on Tuesday decided to purchase an additional thirty motor omnibuses, bringing the total number owned by the department to ninety. It is assumed that these vehicles are to be used in connection with the proposal of the tramways department to run an express service from the city to the suburbs. The department holds the view that a sufficient number of passengers would be prepared to pay more for quick transit to make the omnibuses a commercial proposition, and it is expected that the fares will be about double the tram fares. With the object of making tramcar travelling more comfortable through the elimination of the starting jerk, the Tramways Committee has decided to experiment with the use of high-speed electric motors fitted with a worm drive on the axle, instead of the spur drive now in use.

Enlarging Power Plant.

A recommendation of the Electricity Committee of Preston that permission be sought to raise £138,500 for the purpose of installing a fourth turbine generator set of 17,500 kilowatts capacity in its power station has been adopted by the Finance Committee of the Town Council. The station was opened in July, 1925, with only two sets, but the area of supply is being considerably extended. Preston supplies Leyland, and will shortly be supplying Blackpool and the Fylde Coast generally. Now Southport is asking for a service.

Non-ferrous Metals.

Firm conditions have been a feature of the market for non-ferrous metals during the past week, and in all sections, with the exception of lead, higher values are ruling at the time of writing than a week previously. Lead keeps steady at about the same level as last reported. Dealings in tin during the week have been much less than in the previous week, but, generally speaking, market sentiment has been decidedly firm as an advance of about £4 10s. in spot metal shows, the improvement in the three months' position being rather more pronounced. Buying on United States account has been an important factor, although expectations of a marked reduction in supplies when the February estimates are published have had a very bullish influence. Copper has shown a quiet but steady recovery from the low level reached during the opening of this month, and a further slight advance has taken place compared with a week ago. The improved tone has attracted increased buying interest, and some fair purchases have been made for industrial consumption. Transactions in lead have been on a heavier scale, and after signs of weakness in the closing days of last week, due probably to a certain amount of speculative unloading, prices have recovered the position which they occupied this time last week. Spelter has experienced some fluctuation, but on balance quotations are about 7s. 6d. per ton higher, the demand having shown signs of improving.

Iron.

On several occasions during the past week pig iron makers have experienced a somewhat freer volume of inquiry from consumers, with respect to forward contract deliveries. So far as one can see, however, it has not resulted in any appreciable increase in the aggregate volume of business put through, and one is forced to the

conclusion—and sellers also seem to be taking this view—that much of the inquiry has been circulating with a view to finding out to what extent makers were prepared to modify their ideas. It is not improbable that price concessions would be made if forward contracts of much weight were offered, but 2s. 6d. per ton is about as much as producers would be prepared to concede under present conditions of production costs. For the type of new business that is available, most of it being for relatively small lots, quotations keep steady at 92s. 6d. to 93s. per ton for Staffordshire and Derbyshire common irons, at about 107s. 6d. for Scottish, 95s. 6d. for Middlesbrough, and about 97s. for West Coast hematite. Midland forge irons are being offered at from 80s. to 82s. per ton on rails, at the blast-furnaces. The demand for manufactured iron shows no improvement, but prices remain at £11 15s. per ton for Lancashire Crown bars and £10 15s. for seconds.

Steel.

Steel users in this district apparently still lack confidence in the range of values that are current to-day, and whilst a fair volume of inquiry continues to be reported actual business cannot be described otherwise than as of a quiet nature. Boiler plates are maintained at about £11 10s. per ton, delivered into this area, as are also joists and sections at £7 17s. 6d. to £8, and basic bars at £9 to £9 5s. In the case of ship plates, however, a certain amount of easiness is in evidence, and from £8 2s. 6d. to £8 15s. per ton has been mentioned as the range of market values this week. Imported materials are meeting with a slow market but prices keep steady in most cases, joists being offered at about £6 2s. 6d. per ton, Siemens plates at £7 10s., ordinary plates at £7 2s. 6d. to £7 5s., billets at £5 5s. to £5 7s. 6d., sheet bars at £5 10s. to £5 12s. 6d., and steel bars at £6 to £6 2s. 6d. for cash against shipping documents, and including delivery to users' works in this district. There has been an improvement in the volume of business done in 24 gauge galvanised sheets, and several good parcels have changed hands during the week at about £14 17s. 6d. per ton f.o.b. Thin sheets have also attracted slightly more attention, and values have been reduced to £21 15s. for Straits, £23 12s. 6d. for Rangoons, £22 15s. for Bangkoks, and £24 per ton f.o.b. for Shanghais.

Scrap.

A slightly better tone has been in evidence this week in the market for non-ferrous metal scrap, although up to now it has not been reflected to any important extent in the amount of business done. Prices keep steady at about £39 per ton for brass rod turnings, £44 for selected heavy yellow brass, £51 for selected gun-metal scrap, £54 10s. for clean light copper, £25 10s. for scrap zinc, and £26 10s. for scrap lead, these prices being for sorted qualities, delivered to buyers' works.

BARROW-IN-FURNESS.

Hematite.

The hematite pig iron trade in this district continues to be well employed, and deliveries are heavier than they have been for several years. All the works are well placed for orders covering deliveries during the next few months, and it is hoped that in the early future orders will come in better than they have been doing for delivery during the latter part of the year. There is still an inclination to wait for a reduction in prices on the part of buyers, but in the meantime all the works hold orders which will take them a considerable time to clear if nothing else came in, and further orders seem to be assured by the general trend of business.

Iron Ore.

The activity in the iron ore trade continues to be good and more ore is being raised than for some years. There is a tendency in the Furness district on the part of the miners to ask for bigger wages, but there have been no negotiations in that direction as yet.

Steel.

Makers at Barrow and Workington are well supplied with orders for the present, but the market is not bright, and further orders are needed if the various mills are to be kept employed regularly during the year. This remark does not apply to the hoop mills, which are well booked up, and are likely to remain in that condition.

Shipbuilding and Engineering.

The securing of an order for the building of a repair ship for the Admiralty is good news for Barrow. No particulars are as yet available regarding the size or design of the vessel, but it may be assumed that it will be of large dimensions and will provide a considerable amount of work at Barrow. This order is a good second to the submarine depôt ship which Vickers already have in hand. The repair ship may be driven by M.A.N. internal combustion engines, as will be the depôt ship, but nothing is officially known at present. There are now 2500 less unemployed at Barrow, and this number will be further improved as material comes to hand. Vickers are already proceeding with the Orient liner Orford. The Straits Settlement Navigation Company's fast twin-screw steamer for service between Penang and Singapore is to be launched in June, according to present arrangements.

SHEFFIELD.

(From our own Correspondent.)

Progress of Steel Production.

THERE is some increase to record this week in the production of open-hearth steel in the Sheffield district. Since the termination of the coal strike the furnaces have been engaged to a larger extent than at any previous time since 1920, and Cammell Laird and Co., Ltd., have started an additional one at their Penistone works. That establishment has six furnaces, five of which are in operation. Statistics of the output of steel last year show that Sheffield's total was 545,000 tons, or rather more than half the quantity for 1925. The loss was, of course, accounted for by the long stoppage produced by the coal dispute. It was a smaller proportion of loss than those of some other steel centres. The district's percentage of the grand total rose from 13·7 to 15·3. The output of Lincolnshire was 163,000 tons, as compared with 410,000 tons for the previous year. The extent to which the country's steel trade has revived this year is shown by the January production, which reached 730,000 tons of steel ingots and castings. This total is larger than that of any month last year except March, when 784,000 tons was registered, and it is in excess of any monthly average since 1920. During the last pre-war year the monthly average was nearly 100,000 tons below the January figure. There are prospects of a continuance of the present activity in this district for some months yet, but little new business is being placed. It is felt, however, that much may happen with regard to the placing of contracts before those now on hand are completed, and there is a fair amount of confidence that the position will right itself eventually. There is no reduction yet in the prices of pig iron, producers of which are having to pay high rates for their blast-furnace coke.

Busy Pipe Works.

There are complaints of the scarcity of orders in most branches of the tool trade, including files, and, while there are exceptional cases of activity, the general position of the trade is not so favourable as it was in January. Firms making steel specialities are busy, and well booked forward. One of the busiest local branches is that of the manufacture of cast iron pipes, which is carried on largely in Derbyshire. As pig iron becomes available in larger quantities, outputs are being steadily increased. Order books, in respect of work placed some months ago, are very good, and there is also an encouraging flow of new business. Rather than disappoint their customers in the matter of delivery, the Derbyshire pipe makers are supplementing the supplies of pig iron from their own blast-furnaces by the purchase of some thousands of tons, to be received during the next six months. A very wide area is represented by the contracts on hand, which include pipes for water and other schemes in this country and various parts of the world.

Some Shipping Orders.

Two of the firms, the headquarters of which are in Sheffield, have booked good ship contracts during the week. Vickers Ltd. have secured an order from the Admiralty for a fleet repair ship, which it will build at Barrow. It has recently been able to start several hundred men there, owing to the increased supplies of steel which are now available, and the new order will represent a large amount of work in all departments. The firm is already building for the Admiralty a submarine depôt ship, which will be 600ft. long and will be fitted with internal combustion engines. One of the most important repair and alteration contracts booked on the Mersey for a considerable time is that obtained by Cammell Laird and Co., Ltd., for the refitting of two Canadian Government merchant marine steamers, the Canadian Freighter and the Canadian Skirmisher. The vessels, which were built in Vancouver in 1921, are respectively of 5466 and 5373 gross tons. Included in the contract is the provision of passenger accommodation to meet the requirements of the highest class of ocean travellers between England and Canada.

Cutlery and Plate.

There was a falling off of work in the cutlery and plate departments a month ago, which has been continuous ever since, and the volume of business coming in now is considerably below what it was in February of last year. Several of the leading houses, who have kept up quality and price, have order books of a fairly satisfactory character, but a sharp drop in the demand for sixpenny and other very cheap lines is severely hitting some of the smaller makers. Shop and storekeepers do not appear to be inclined to order with freedom, as counter trade has been very meagre since the beginning of the year. Substantial Government contracts for cutlery and plate are about to be placed, and, owing to the flatness of general trade, competition for them is sure to be very keen. The Admiralty is now inviting tenders for more than 100,000 unplated table spoons, table forks, tea spoons and soup ladles, 5000 plated tea and coffee spoons and a number of spare cruets, 1200 carving knives, 1200 carving forks, 1200 steels, 1600 cooks' knives, 500 butchers' knives, 350 bread knives, 27,000 one-piece table knives, and several smaller items.

Coal-cutting by Electricity.

Electrically driven coal-cutting machinery was recently introduced at the Swallow Hill Colliery, near Barnsley, and it has reduced costs so much, in comparison with the hand-getting system, that the owners have decided to dispense with hand-getting altogether, and have given notice to all the eighty-four men employed on hand work, as well as a few deputies and datallers, to terminate their engagements. In order to obviate unemployment, they are prepared to find work for the men at their Woolley collieries. The seam worked at Swallow Hill is the Lidgett, which is only a little over 2ft. thick and hard to work, and the owners state that they have been working the colliery at a loss for a long time.

Goole Water Tower.

I have on previous occasions referred to the building at Goole of a great water tower, the largest of its kind in the country. It has now been completed and tested. It holds 750,000 gallons, and Mr. E. J. Silcock, of Leeds, the consulting engineer, reports that it is in a satisfactory condition, and can be brought into use whenever required. The contractors were Messrs. H. Arnold and Son, of Doncaster.

New Commercial Secretary.

The Council of the Sheffield Chamber of Commerce has decided to appoint Mr. A. J. C. Walters, of Manchester, as secretary, in succession to Mr. Albert Law, who is retiring in March, after nine years' service. Mr. Walters has for some time been assistant secretary of the Manchester Chamber of Commerce, in his work for which he has specialised in the African section, the Rumanian debts, and railway rates. He is secretary of the Manchester and District Confederation on Railway Rates, and was recently appointed secretary to the Manchester branch of the Wholesale Textile Association.

NORTH OF ENGLAND.

(From our own Correspondent.)

More and More Work.

INDUSTRIAL prospects in the North of England continue to improve, and the outlook is better than at any time since 1921. Work in all sections is coming forward in increasing volume. Particularly gratifying is the position in the shipbuilding trade. Several of the larger shipyards have enough work for more than a year, and one, at least, has sufficient for two years. The latest order has been secured by Craig, Taylor and Co., Ltd., Stockton-on-Tees, and the news has been received in the immediate district with acclamation as it comes after a long period of depression. The three yards at Stockton have been closed since 1924, and two have been in liquidation. The order is for two steamers of 8400 tons each, and has been secured from Humphries (Cardiff), Ltd., owners of the Globe Shipping Company, and the Hazelwood Shipping Company. The engines for the vessels, too, will be built at Stockton, Blair and Co., Ltd., having obtained the contract for them. Two years have elapsed since Craig, Taylor and Co. closed down their yard through lack of work. At that time they had embarked upon the construction of a ship to keep their men in employment, but as the prospect of selling dwindled with the increasing acuteness of the depression, operations on the work were suspended. In the meantime the plant and machinery has been maintained in first-class order against the day when work would be resumed, so that a prompt start can now be made. The Tees-side Bridge and Engineering Company, Middlesbrough, has obtained a contract from the Admiralty for sixteen large oil tanks, the construction of which will involve the employment of a great deal of skilled and semi-skilled labour. In addition, the local steel mills will be called upon to supply approximately 6000 tons of plates and sections. The tanks will be erected upon the Admiralty's site at Pembroke. Apart from this contract, the Tees-side Bridge and Engineering Company has a considerable amount of work in hand in both the bridge and foundry departments, but at the moment the firm's operations are somewhat hampered by the inadequate supply of steel materials.

Cleveland Iron Trade.

The Cleveland iron trade shows signs of returning animation. Whilst actual sales are on a scale considerably below what could be desired, indications of a steady expansion in trade are noticeable. Inquiries are improveing, and a more confident feeling as to the likely level of future values is an encouraging feature. The firming up of certain continental products affords some satisfaction to producers in this area, but keen foreign competition has still to be contended with in markets abroad. There is still only a comparatively small quantity of pig iron available for the open market, the steel works continuing to absorb the bulk of the output. Many buyers, however, are only prepared to pay present prices under the impulse of stern necessity. Frankly, they are disappointed that pig iron prices have not fallen, but these latter in turn are governed by the price of blast-furnace coke, which is actually dearer than it was a few weeks ago. Pig iron prices show no variation, No. 1 Cleveland foundry being 87s. 6d.; No. 3 G.M.B., 82s. 6d.; No. 4 foundry, 81s. 6d.; and No. 4 forge, 81s. for home consumption. Export prices are 6d. per ton more in each case.

Hematite Pig Iron.

The position in the East Coast hematite pig iron trade is a trifle easier. West Coast makers are competing keenly for orders, and some price cutting is reported. But for named brands, 90s. per ton is the general quotation of East Coast makers, and the price could probably not be cut by more than 1s. per ton.

Ironmaking Materials.

The price of blast-furnace coke is firm at 27s. 6d. per ton delivered at the works, and producers deny that they are exploiting the situation. They affirm that the quoted price leaves only a modest margin of profit. On the other hand, it is more than the ironmasters can afford to pay, and it looks as though coke prices would have to come down or blast-furnaces go out of action. The ore trade, based on best Rubio ore at 22s. 6d. per ton c.i.f. Tees, is quiet, but good deliveries under contract are coming to hand.

Manufactured Iron and Steel.

Conditions in the manufactured iron and steel trade show little change. Most of the works are very busily employed, but in some branches of the trade contracts are being executed more rapidly than new orders are being secured, and producers would welcome an increased demand. Inconvenience is still caused to shipbuilders through inadequate deliveries of plates and sections. A drop of 10s. per ton is recorded in the price of common iron bars, which are now quoted £11 15s. per ton.

The Coal Trade.

A number of foreign inquiries for large quantities of steam and gas coals have been circulating this week. Interest in these inquiries has been keen, and hopes are entertained that the German competition will be satisfactorily met, for there is great determination in that

country to retain the position gained in foreign markets during the strike of last year. Collieries are carrying on from day to day with prompt orders, and are maintaining shipments at a fairly high level. The recent full range of prices is asked. Best steams are steady for next month at about 16s. 9d. per ton direct. For small steams the demand is dull, and stocks are steadily increasing; 10s. to 10s. 6d. is quoted for ordinary best brands. Gas coals for all positions are just barely steady. Best qualities are offered at 17s. to 17s. 6d., and secondary at 15s. 6d. to 16s. Although the production of coke is increasing, the demand is steadily expanding, and all output is readily snapped up. Patent foundry cokes are firm at 26s. to 28s., and gas coke remains scarce at 23s. to 23s. 6d.

SCOTLAND.

(From our own Correspondent.)

Unchanged Conditions.

THE past week has brought no change in market conditions generally. Several departments of industry are busy and others are becoming more active, but that is more or less the result of works being gradually restarted in order to deal with back orders. In most markets new business is as scarce and elusive as ever, and neither home nor foreign buyers appear to regard the time opportune or the terms offered sufficiently attractive to indulge in forward transactions, or, in fact, to purchase anything beyond immediate requirements.

Steel.

The activity of the steel works is the principal industrial feature in Glasgow and the West of Scotland at the moment. All classes of consumers, but especially shipbuilders, are pressing for delivery of orders, many of which were held up during last year's strike. Numerous contracts have yet to be fulfilled, and provided that there are no interruptions the works should be well engaged for some time to come. The situation, then, is unusual, and buyers are confident that when things slacken off the level of prices will fall, and are consequently content to await such eventualties. Meanwhile, prices are unchanged.

Steel Sheets.

Black and galvanised sheets continue to experience a steady flow of orders, particularly the better qualities. Reports state that considerable quantities of galvanised sheets have been sold to exporters at the lower prices recently quoted. Black sheets range between £12 and £13 for ⅜ in. to ½in., delivered Glasgow, and galvanised corrugated sheets from £15 10s. to £16 10s., f.o.b. Glasgow, for 24 b.g.

Iron.

The ironworks are moderately busy. Bar iron is in fair demand and steady at £11 15s. per ton, home delivery, while a moderate turnover is being done in the re-rolling department. Re-rolled steel averages about £8 10s. per ton, home or export.

Pig Iron.

The present demand for all grades of pig iron is rather quiet. Supplies are ample, despite restricted outputs, with the possible exception of certain brands of foundry. Hematite is plentiful enough, but some producers of foundry still find some difficulty in securing standard quality. Prices are nominally unchanged.

Coal.

The situation in the coal trade cannot be termed satisfactory. Buying is still of a restricted character, despite the fact that prices of some descriptions are almost at pre-strike level. Further, some collieries state that as the longer hours worked do not compensate for the withdrawal of the subsidy to sell at current prices means a loss. Home industrial demands are still below normal, while many gas companies and the railways continue to work off stocks of American fuel. The export market is slow and prices lack stability. Lanarkshire ells and splints have lost their firmness, and Fifeshire steams are about the only description to preserve their position. All Lothians fuels require fresh orders. Some good shipments of washed singles and pearls have been reported, but on the whole all washed materials are rather difficult to dispose of, and prices are inclined to weaken. Aggregate shipments amounted to 215,782 tons, against 282,960 tons in the preceding week, and 214,552 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

EXPORTS of coal from this district last week were rather disappointing, as they were 75,000 tons less than during the preceding week, when the highest figure since the national coal stoppage was reached. The falling off was entirely due to the restricted supply of tonnage available, and unfortunately the position in this respect is little better this week, as arrivals of steamers over last week-end were below expectations. Nevertheless, the general tone of the steam coal market is no worse. In fact, in some directions it can be said that the conditions are a shade steadier, although this slight improvement has not as yet shown itself in actual values, which are still somewhat irregular for prompt shipment. Nevertheless, the feeling is growing that the market on the whole has about touched bottom, though it may be some time before there is any definite upward movement. The inquiry is undoubtedly broadening, and already a very considerable amount of business has been carried through, and substantial contracts are now being negotiated. One prominent undertaking is reported to have sold approximately 1,000,000 tons of coal for delivery over the remainder of this year at prices between 20s. 6d. and 21s., the purchasers being one of the leading liner companies to the extent of about 300,000 to 400,000 tons, while it is understood that about an equal quantity has been bought by a well-known foreign coal contracting concern. Tenders have gone in for 120,000 tons of patent fuel for the Algerian State Railways, which are also on the market for about 32,000 tons of sized coals. Portuguese Railways have contracted for about 30,000 tons of smalls for fairly early delivery and the Portuguese State Railways are inquiring for about 10,000 tons of small coals. Reference has already been made to the adjudication which takes place on March 1st for 100,000 metric tons of steam coals for the Egyptian State Railways. In addition, the Norwegian Navy is in the market for supplies, though the probability is that only a small part of its order, if any, will come to this district. Negotiations are also proceeding with a number of foreign consumers for supplies of leading qualities of large coals amounting to as much as 15,000 tons for shipment over the rest of this year. Altogether, there is reason to think that business is really beginning to move, now that buyers are coming round to the view that prices are touching the bottom level.

Ships and Ship-repairing.

The outlook cannot be so bad when it is the fact that Cardiff shipowners continue to place orders for new tonnage. The latest contract entered into is that by Mr. T. B. Humphries, principal of Humphries (Cardiff), Ltd., the managers of the Hazelwood and Globe Shipping companies, for two new steamers of about 8400 tons deadweight. These steamers, which are to be of the open shelter deck type, are to be built throughout of British material. The contract has been placed with Craig, Taylor and Co., Ltd., of Stockton-on-Tees. This brings the number of steamers contracted for by Cardiff shipowners recently to a total of twenty-two, of an aggregate deadweight capacity of 183,000 tons. Ship-repairing operations in South Wales continue to be fairly active, and it is satisfactory to see that progress is being made towards a settlement of the question of revised working conditions in this district, so that employers can fairly compete for orders with other areas.

Effect of Coal Stoppage.

How colliery undertakings suffered as the result of the coal stoppage last year is shown by the announcement of the Powell Duffryn Steam Coal Company, which is one of the most up-to-date undertakings, both on its colliery side and its commercial management. The company sustained a loss of £118,810, whereas in 1925 its profits amounted to £240,316, while in 1923 it reached the figure of £523,762. Notwithstanding the loss of last year, however, the ordinary shareholders are to receive a 2½ per cent. dividend, less income tax, so that it is evident that the company is encroaching upon its reserves to pay this distribution, which will be very welcome to shareholders. The directors have always pursued in the past a very cautious and sound policy in financial matters, and it is generally concluded that in now paying an ordinary dividend they have great faith in the future, and expect very soon to make up the leeway that has been lost.

Tin-plate Trade.

The conditions in the tin-plate trade are none too satisfactory at the present time. A considerable quantity of foreign steel is being utilised in the manufacture of Welsh tin-plate, owing to the fact that there is such a disparity in the price between this material and Welsh bars. At the same time, the latter are more suitable for certain specifications of tin-plate, and consequently fairly large quantities of Welsh bars are being consumed in many of the West Wales works. High costs of production have operated against Welsh bars being brought down in price below £6 15s. per ton delivered, or about 35s. per ton more than foreign bars c.i.f. As, however, these costs are tending downwards, it has been decided by prominent steel manufacturers to reduce Welsh bars to £6 10s. per ton delivered as from March 1st. This reduction of 5s. per ton will assist the tin-plate trade, as these bars are much preferred to foreign steel, even at a higher figure.

Current Business.

Operations on current account can scarcely be described as active, but the outlook is slightly better. A steady improvement is much to be preferred than a rush of orders followed by a lull. A fair number of orders are already held, but the tonnage difficulty is an important factor. Supplies are slow to come along in adequate quantity, with the result that many collieries find it hard to keep their pits working regularly, and this fact, of course, increases their costs of production. Best Admiralty large coals continue round about 22s. 6d. to 23s., while superior small coals are very steady on the basis of about 15s., owing to the restricted outputs consequent upon the intermittent working at the collieries. Patent fuel is quoted at slightly lower figures. Prices of this commodity have ruled at comparatively high figures in relation to the values of coals, entirely as a result of the exceedingly high costs and scarcity of pitch. British makers of pitch have demanded 110s. to 115s. per ton, which has compelled manufacturers of patent fuel to look elsewhere for their supplies, and recently the ss. Dorie Jensen arrived at Cardiff with 3200 tons of American pitch from Baltimore, this being imported by the Crown Preserved Coal Company for the making of patent fuel.

LAUNCHES AND TRIAL TRIPS.

SIN KHENG SENG, single-screw steamer; built by Harland and Wolff, Ltd., to the order of McKie and Baxter, Ltd.; for use in the Straits Settlement coasting trade; principal dimensions, 110ft. by 22ft. by 9ft. 6in.; 200 gross tonnage. Engines, triple-expansion, surface condensing; constructed by McKie and Baxter, Ltd.; launch, February 17th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

J. M. WOTHERSPOON AND CO., Ltd., of 194-200, Bishopsgate, London, ask us to announce that they have opened an office at Amrut Building, Ballard Estate, Bombay, which will be under the charge of Mr. H. F. Hogan.

GREENWOOD AND BATLEY, Ltd., of Leeds, ask us to announce that they have appointed Haslam and Stretton, Ltd., of 11, Windsor-place, Cardiff, to represent them in the South Wales district for the sale of their products.

MR. R. H. YAPP asks us to announce that he has severed his connection with Arrol (Swansea), Ltd., and has joined the staff of Braithwaite and Co., Engineers, Ltd., of Newport, Mon., as engineer representative for the South Wales and West of England area.

E. H. HUNTER AND CO. ask us to announce that, on March 1st, 1927, they are moving from 9, Billiter-square, E.C. 3, to larger and more convenient offices at 68, Victoria-street, London, S.W. 1. Their new telegraphic address will be "Opals, Sowest, London."

BABCOCK AND WILCOX, Ltd., ask us to announce that at the board meeting held on February 17th Mr. A. Spyer was appointed general manager and Mr. C. S. Davy was appointed assistant general manager of the company. An administrative committee has also been formed.

J. BLAKEBOROUGH AND SONS, Ltd., of Brighouse, Yorks., ask us to state that they have acquired from Nuswift (Bradford) the sole manufacturing and selling rights of the "Nuswift" patented fire extinguishers. The services of Mr. J. A. Goodall, the patentee, have been retained and business will in future be dealt with at the company's works at Brighouse, to which address it is requested that all communications should be forwarded.

AGRICULTURAL AND GENERAL ENGINEERS, Ltd., asks us to announce that Sir Charles E. Low, K.C.I.E., formerly Secretary to the Commerce and Industry Department of the Government of India, and a member during the war of the Indian Munitions Board, has been appointed to take charge of the Indian interests of the fourteen engineering firms it controls.

CONTRACTS.

VICKERS Ltd. announce that they have received an order from the Admiralty for a fleet repair ship.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has obtained a six months' contract from the Southern Railway for the supply of Mazda electric lamps, as from March 1st.

W. R. MORRIS, successor to Wolseley Motors, Ltd., of Adderley Park, Birmingham, has received from the India Office an order for twenty-eight new Wolseley 16-45 horse-power Light-Six cars for use in India.

J. BLAKEBOROUGH AND SONS, Ltd., of Brighouse, have been awarded the contract for the supply of the necessary valve equipment in connection with the Nippon Electric Power Company's development at Komaki, on the Sho River, Japan. This equipment is for controlling the supply of water to four turbines of the Francis reaction type, with an aggregate development of 126,000 horse-power, and consists of four Larner-Johnson valves, each 11ft. diameter, for a working head of 176ft.

WORTHINGTON-SIMPSON, Ltd., of Newark-on-Trent and Queen's House, Kingsway, London, W.C. 2, have received from the Dyer Company, of Pall Mall, London, an order for the supply of the pumping and compressing plant for installation at a new sugar factory to be erected at Bardney, Lincs. The order includes three boiler feed pumps, two duplex steam-driven carbonic acid gas compressors of approximately 2000 cubic feet capacity each per minute, one 600 cubic feet feather valve air compressor, three steam-driven dry vacuum pumps of 2200 cubic feet capacity, and thirty-two centrifugal pumps ranging in size from 3in. to 12in.

CALENDARS, DIARIES, &c.

BROWNLIE AND MURRAY, Ltd., Possil Ironworks, Glasgow.—Wall calendar with daily change slips.

NORMAN, PEARSON AND CO, Ltd.—Wall calendar with daily tear-off slips.

CONSOLIDATED PNEUMATIC TOOL COMPANY, Ltd., 170, Piccadilly, W. 1.—Two wall calendars with monthly tear-off sheets.

W. G. BEAUMONT AND SON, Priory Works, Bow, E. 3.—Wall calendar with monthly tear-off slips.

THE INSTITUTION OF CHEMICAL ENGINEERS.—Examinations for the associate-membership of the Institution of Chemical Engineers will be held in June and July next. Particulars may be obtained on application to the hon. registrar, Mr. C. S. Garland, the Institution of Chemical Engineers, Abbey House, Westminster, London, S.W. 1. Applications for entry must be received not later than May 1st, 1927.

INSTITUTION OF QUARRY MANAGERS.—The annual conference of the Institution of Quarry Managers is to be held this year at Harrogate from June 27th to July 2nd inclusive. An exhibition of quarrying machinery, plant, &c., is to be held in conjunction with the conference. An innovation this year is that instead of having a few lengthy papers read at the conference, a number of lecturettes are to be given, the time allowed for each lecturette being eight minutes. Time for discussion will be allowed.

ASSOCIATION OF CONSULTING ENGINEERS.—The annual dinner of the Association of Consulting Engineers was held at the St. Stephen's Club, Westminster, on the evening of Wednesday last, the 23rd inst. Over a hundred and fifty members and guests sat down, under the chairmanship of Mr. W. J. E. Binnie, M. Inst. C.E., who is this year chairman of the Committee of the Association. The dinners of this Association are always most enjoyable—perhaps, largely, because there is so little formality about them. Wednesday's event was in no way an exception to the general rule; we spent a delightful evening, and, judging by appearances, so did everyone else. The toast of "The British Empire," which was proposed by Sir Cyril Kirkpatrick, was to have been replied to both by Lieut.-Colonel the Right Hon. Wilfrid Ashley and the Hon. Mr. J. S. Smit—the High Commissioner for the Union of South Africa. Col. Ashley was unavoidably prevented by his Parliamentary duties from being present, and the whole onus fell on Mr. Smit, who gave a dissertation on the relationship between the Union and the Mother Country. The toast of the "Bench and the Bar," ably introduced by Mr. S. C. Lewis, M. Inst. C.E., was wittily replied to by the Master of the Rolls and Mr. W. E. Tyldesley Jones, K.C. The speeches of the representatives of the Bench and the Bar, are, by the way, always salient features of these entertainments. The toast of "Science," offered by Mr. N. G. Gedye, M. Inst. C.E., was responded to learnedly and at some length by Dr. J. Vincent Elsden, F.G.S., and the programme was brought to a conclusion by the toast of "The Association," which was proposed by Mr. Frederick Palmer and replied to by the Chairman.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/–
(1) Spanish	18/6 to 21/–
(1) N. African	18/6 to 21/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 7 6	—
No. 1 Foundry	4 15 0 to 4 17 6	—
No. 3 Foundry	4 10 0 to 4 12 6	—
N.E. COAST—		
Hematite Mixed Nos.	4 10 0	4 10 0
No. 1	4 11 0	4 11 0
Cleveland—		
No. 1	4 7 6	4 7 6
Silicious Iron	4 7 6	4 7 6
No. 3 G.M.B.	4 2 6	4 3 0
No. 4 Foundry	4 1 6	4 2 0
No. 4 Forge	4 0 6	4 1 0
Mottled	4 0 0	4 0 6
White	4 0 0	4 0 6
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	4 0 0	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	4 0 0 to 4 2 6	
Foundry Forge	3 13 0	—
(3) Derbyshire—		
No. 3 Foundry	4 2 6 to 4 5 0	
Forge	3 18 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 2 6 to 4 5 0	
No. 4 Forge	—	—
Basic	4 0 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 17 6 (a); 5 0 6 (b); 5 4 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 15 0	—
Best	—	—
N.E. COAST—		
Common Bars	11 15 0	—
LANCS.—		
Crown Bars	11 15 0	—
Second Quality Bars	10 15 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	11 15 0	—
Best Bars	13 10 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	12 0 0	—
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	11 0 0	—
Gas Tube Strip	13 5 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ⅜in. and up	8 7 6 ..£8 0 0 to 8 5 0	
Sections	7 17 6 ..£7 10 0 to 7 15 0	
Steel Sheets, under 3/16 in. to ¼in.	12 0 0 to 13 0 0	
Sheets (Gal. Cor. 24 B.G.)	—	£15 10 0 to 16 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 10 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0†	—
Light Rails	8 15 0 to 9 0 0	
Billets	8 0 0 to 11 10 0†	
MANCHESTER—		
Bars (Round)	9 0 0	—
,, (Small Round)	9 0 0	—
Hoops (Baling)	11 0 0	11 0 0
,, (Soft Steel)	10 15 0	10 15 0
Plates	8 15 0	—
,, (Lancs. Boiler)	11 10 0	—
SHEFFIELD—		
Siemens Acid Billets	11 0 0	—
Bessemer Billets	11 0 0	—
Hard Basic	9 2 6	—
Intermediate Basic	8 12 6	—
Soft Basic	7 15 0	—
Hoops	12 0 0	—
Soft Wire Rods	10 0 0	—
MIDLANDS—		
Small Rolled Bars	8 15 0 to 9 0 0	
Billets and Sheet Bars	7 0 0 to 7 5 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	13 5 0 to 15 7 6	
Angles	7 17 6 to 8 0 0	
Joists	7 17 6 to 8 0 0	
Tees	9 0 0	—
Bridge and Tank Plates	8 17 6 to 9 2 6	
Boiler Plates	11 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/9 to 20/–
Block Tin (cash)	308 10 0
,, (three months)	298 10 0
Copper (cash)	55 0 0
,, (three months)	55 10 0
Spanish Lead (cash)	27 17 6
,, (three months)	28 5 0
Spelter (cash)	30 7 6
,, (three months)	30 12 6
MANCHESTER—	
Copper, Best Selected Ingots	60 15 0
,, Electrolytic	62 7 6
,, Strong Sheets	86 0 0
,, Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price) lb.	0 0 11½
,, Condenser lb.	0 1 1½
Lead, English	29 12 6
,, Foreign	28 5 0
Spelter	30 12 6
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 10 0	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 0 0	6/6
,, ,, Specially Refined		
,, ,,Max. 2 p.c. carbon	£36 2 6	11/6
,, ,, ,, 1 p.c. ,, ,,	£42 5 0	15/–
,, ,, ,, 0.70 p.c. carbon	£54 0 0	17/6
,, ,, ,, carbon free	1/5d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£16 for home, £16 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 10 0	scale 5/– per unit
,, ,, ,, 75 p.c.	£18 10 0	scale 6/– per unit
,, Vanadium	14/9 per lb.	
,, Molybdenum	5/3 per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Cobalt	9/– per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	16/–
,, ,, Ell	16/9
,, ,, Splint	17/– to 19/–
,, ,, Trebles	18/–
,, ,, Doubles	16/–
,, ,, Singles	15/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	17/–
,, ,, Jewel	19/–
,, ,, Trebles	18/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	14/– to 16/–
Screened Navigation	22/9
Trebles	18/– to 18/6
Doubles	16/6
Singles	15/–
LOTHIANS—	
(f.o.b. Leith)—Best Steam	15/–
Secondary Steam	14/3
Trebles	17/9
Doubles	16/9
Singles	14/6

ENGLAND.

(8) N.W. COAST—	
Steams	27/6
Household	*No quotation.*
Coke	31/6
NORTHUMBERLAND—	
Best Steams	17/– to 17/3
Second Steams	15/6 to 16/–
Steam Smalls	11/–
Unscreened	15/6 to 16/–
Household	23/– to 30/–
DURHAM—	
Best Gas	17/3 to 17/9
Second	15/9 to 16/3
Household	23/– to 30/–
Foundry Coke	26/6
SHEFFIELD—	Inland.
Best Hand-picked Branch	40/–
Best Selected House Coal	34/– to 35/– —
Barnsley Best Silkstone	30/– to 32/– —
Derbyshire Best Brights	30/– to 32/– —
,, ,, House	28/– to 30/– —
,, ,, Large Nuts	26/– to 28/– —
,, ,, Small	18/– to 21/– —
Yorkshire Hards	19/– to 21/– —
Derbyshire Hards	19/– to 21/– —
Rough Slacks	12/– to 12/6 —
Nutty Slacks	8/6 to 9/6 —
Smalls	3/– to 6/– —
Blast-furnace Coke (Inland)	20/– to 25/– at ovens.*
,, ,, (Export)	f.o.b. 26/– to 27/–

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	22/– to 23/–
Second ,, ,,	21/– to 22/–
Best Dry Large	21/6 to 22/–
Ordinary Dry Large	20/6 to 21/–
Best Black Vein Large	21/9 to 22/3
Western Valley Large	21/6 to 21/9
Best Eastern Valley Large	21/– to 21/6
Ordinary ,, ,,	20/6 to 21/–
Best Steam Smalls	14/6 to 15/3
Ordinary Smalls	12/– to 14/–
Washed Nuts	20/– to 24/6
No. 3 Rhondda Large	27/– to 27/6
,, ,, Smalls	18/– to 19/–
No. 2 ,, Large	21/– to 22/–
,, ,, Through	18/– to 19/–
,, ,, Smalls	13/– to 14/–
Foundry Coke (export)	40/– to 45/–
Furnace Coke (export)	25/– to 30/–
Patent Fuel	27/– to 27/6
Pitwood (ex ship)	31/– to 32/–
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	35/– to 36/–
Seconds	29/– to 32/6
Red Vein	27/6 to 29/–
Machine-made Cobbles	42/6 to 45/–
Nuts	47/6 to 52/6
Beans	44/– to 46/–
Peas	22/6 to 25/–
Breaker Duff	9/– to 9/6
Rubbly Culm	13/6 to 14/–
Steam Coals :	
Large	22/– to 23/–
Seconds	21/– to 22/–
Smalls	12/– to 14/–
Cargo Through	17/– to 18/–

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayreshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. † Latest quotations available.

(a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. * Open market price. Special price for pig iron producers, 19/– per ton at ovens.

French Engineering Notes.

(*From our Correspondent in Paris.*)

Wages and Prices.

IT is reported that there has been a little more buying on export account, but the volume of business done has certainly not influenced the general situation, which is only prevented from degenerating into a collapse by a feeling that the crisis cannot be of long duration. That does not, however, prevent a continued slowing down of activity, and firms which have been keeping their hands on short time now find it necessary to discharge a large proportion of them, with the result that the official figures of unemployed show an increase of about 10,000 a week. The actual number of men out of work is unknown, but it is generally considered to be much greater than is represented. Confidence in the future can obviously only be justified in the event of production costs being reduced. They have been considerably increased by the higher charges, and, in the annual report of the Union des Industries Métallurgiques, reference is made to the relatively high scale of wages which were repeatedly advanced during the period of currency depreciation. It is true that the ratio of wages to living costs has undergone little change, and logically, the cost of living can only decline with a fall in wages. The latter are at present too high to permit of a recovery of trade, and it is significant that certain firms which discharged hands are now taking some of them back at lower wages. Everywhere the prices of manufactured goods are being reduced in the hope of securing orders, but that cannot be done economically unless the men themselves make some sacrifice, which, however, is only temporary, since living costs will adjust themselves to wages. In the iron and steel trades prices are further weakening on account of the small consumption, and, also, of fear of British competition, for it is regarded as fairly certain that British producers will soon be offering supplies of pig iron and rolled steel in the continental markets. The necessity of keeping up iron and steel prices at a profit-making level, is the sole reason why strong efforts are being made to adjust the differences that threaten the existence of the Steel Cartel.

Motor Car Trade.

The motor car industry has owed its recent prosperity to the facilities offered by a debased currency for doing business in foreign markets. So long as the franc remained at a low level there was a considerable amount of speculative buying, and the low prices at which French cars were sold in countries with a normal currency allowed of the factories working to their full capacity. On the franc suddenly reaching the present level, where it is more or less stabilised for the time being, motor car makers found themselves deprived of the foreign trade. Contracts were cancelled, a huge accumulation of chassis obliged most firms to discharge hands, and the situation all round was regarded as disquieting. It has improved slightly since then, and some of the firms are doing better, but, on the whole, the automobile industry is in a condition which points clearly to the necessity of an entire reorganisation. At first, United States' capital attempted to control the industry indirectly through the medium of one of the oldest French firms which endeavoured to create a combine of four companies, including De Dion-Bouton, the object being for each company to specialise in one or two types of cars, and an organisation would be created for the purchase of raw material for the different makers and for the sale of the vehicles. The system was to be the same as that in vogue in the United States. The negotiations fell through when it was found that De Dion-Bouton was too far gone to justify any hope of salving it. That company, which shared with Panhard and Peugeot the distinction of being the oldest in the world, has gone into liquidation. The situation of most of the other firms is far from brilliant, and it is impossible to say how they will fare unless something is done to recover the foreign trade. The only hope of doing that is to get down costs, for which purpose efforts continue to be made to constitute a general organisation by a pooling of capital, but it is by no means certain that any definite result will be achieved.

African Railways.

Between Algeria and Tunis, the one a colony and the other a Protectorate, there has always been a tendency towards isolation, and nothing has been done to facilitate intercourse except by means of the railway which runs across the north of Africa to Morocco. There is practically no communication between the two territories farther inland. At present a line runs southwards from Bone to Tebassa and another from Tunis to Kala-Djerda. The distance between the two towns is about 36 miles, and it has been decided to connect them up with a railway which will include the line already existing between Tebessa and the phosphate mines of Kouif. Algeria has voted a sum of 4,000,000 francs as its share of the expense.

Foreign Trade.

The returns of foreign trade during January show a considerable declension as compared with those for the previous month. The imports, valued at 4079 million francs, declined on the month by 1043 million francs, while the exports, totalling 4708 million francs, were 686 million francs less than in December. Compared with January last year there was a decline in imports of 417 million francs and an increase in exports of 849 million francs. In quantities imports amounted to 4,064,152 tons, an increase on December of 25,226 tons, and exports totalled 2,791,388 tons, a decrease of 17,365 tons. The increases as compared with January of last year were respectively 451,476 tons and 524,178 tons. The figures show that since the relative stabilisation of the franc there has been a heavy falling off in the imports of raw material and a considerable declension in the exports of manufactured goods.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

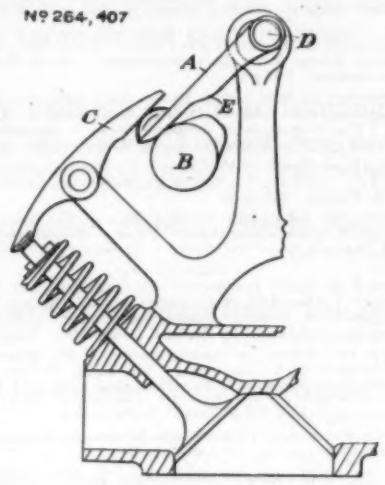
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

264,407. August 4th, 1926.—VALVE GEAR, S. C. Newson, 21, Alwyne-villas, Canonbury, London, N. 1, and the Laystall Motor Engineering Works, Ltd., Ewer-street, Southwark.

In this valve gear a secondary lever A is interposed between the cam shaft B and the rocker lever C. The lever A is pivoted

Nº 264,407



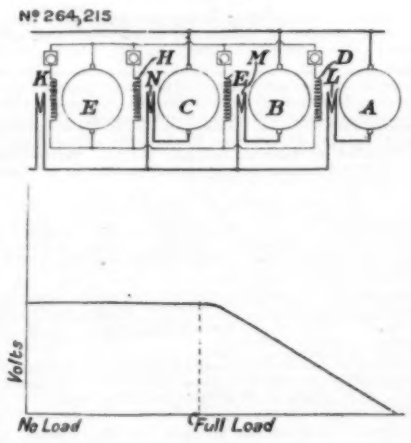
on an excentric pin D. As shown, the valve will be operated normally, but, if the excentric is turned, the lever A will be pushed forward so that the cam engages with the raised part E, which will produce an earlier opening of the valve. At the same time the closing will be delayed as the cam will not leave the end of the lever so soon.—*January 20th*, 1927.

DYNAMOS AND MOTORS.

264,215. October 12th, 1925.—IMPROVEMENTS IN AND RELATING TO THE CONTROL OF DYNAMO-ELECTRIC MACHINES, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2, and Alan Adair Pollock, of "Croxton House," Sherbourne-place, Leamington Spa, Warwick.

In accordance with this invention, three generators A, B and C, are mounted together with an exciter E on a common shaft driven by a water turbine. The exciter E is used for the excitation of all three generators by means of their separately excited fields D, E and H, the overcompounding of the exciter

Nº 264,215



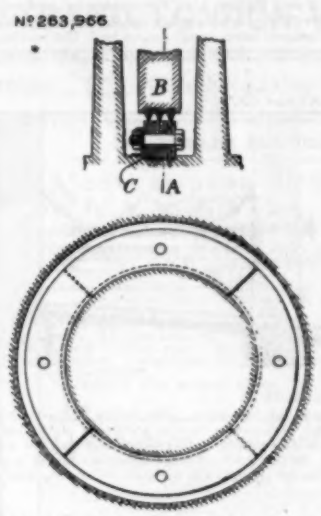
E being effected by the coil K, which takes the full current of a group of machines, or a shunted portion thereof, the drooping characteristic of the individual generators being obtained by means of the differential series windings L, M, and N. The lower diagram shows the type of load characteristic which will be obtained from such an equipment, and shows the voltage to be practically constant up to full load, and then rapidly falling off on overload. It will, of course, be understood that the voltage load characteristic for the working range of the machine, that is, from no load to full load, may be rising or drooping if desired, by suitable modification in the effective value of the compounding coil K on the exciter.—*January 12th*, 1927.

TURBINE MACHINERY.

263,966. October 16th, 1925.—PACKING RINGS, The English Electric Company and A. H. Law, Queen's House, 28, Kingsway, London, W.C. 2.

In order to protect the turbine spindle A from being overheated in the event of it rubbing on the packing B, it is protected by a ring C in such a manner that heat communicated to it by contact with a strip on its outer periphery will have become distributed over a relatively large surface before it is communicated to the shaft part of the rotor, whereby dangerous localised heating of the latter is avoided. The rings may be made separately in sections which require to be joined together in position. A convenient form of construction appears to be one in which each ring is formed of a number of relatively thin plates, each occupying half of the circle, adjacent plates being arranged so that their joints are staggered and the overlapping ends provide a means for attachment. The attachment may be made by passing a bolt through holes in the overlapping ends.

Nº 263,966



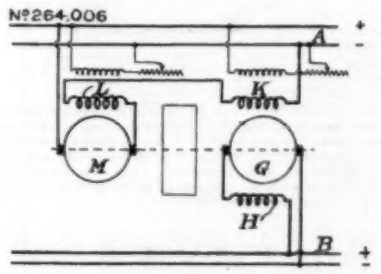
To facilitate this, oval bolts may be used so that they may be inserted through the holes while the latter are not in register, after which, by turning the bolts from the initial position in which their long axes are radial to a position in which these axes approach the tangential, the ring may be securely tightened on to the shaft. Preferably, a slight recess is provided in the shaft surface to receive each of the rings.—*January 13th*, 1927.

ELECTRICAL APPLIANCES.

264,006. December 18th, 1925.—IMPROVEMENTS IN AND RELATING TO ELECTRIC DISTRIBUTION SYSTEMS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2, and Hugh William Conway Liddiard, of 1, King Edward-road, Rugby.

The object of the arrangement shown in the diagram is to avoid fluctuations on the system B disturbing the voltage on the system A. M is a direct-current motor driving a direct-current generator G. On the motor generator shaft a fly-wheel is mounted. Both the motor and generator shunt field systems are supplied from the system A. In addition to its ordinary series field H, an additional auxiliary field winding K is connected in

Nº 264,006



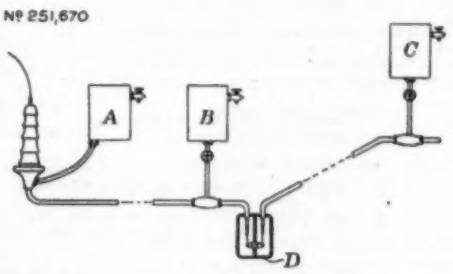
series with the leads to the motor armature, which has a single series winding L arranged to give a comparatively large speed drop in the motor generator set when the load comes on the motor shaft. Sudden fluctuations in load in system B cause the fly-wheel to give up energy, and so limit the disturbance on system A. The series field H on the generator takes care of the normal regulation of the generator due to its own load. In addition, however, it is necessary to take care of the voltage variation due to the drop in speed, and that is done by the series field K. Since the drop in speed of the motor generator set is approximately proportional to the load on the motor, such a series field can be made substantially to correct the voltage due to such a drop in speed.—*January 13th*, 1927.

TRANSMISSION OF POWER.

251,670. May 3rd, 1926.—IMPROVEMENTS IN ELECTRIC CABLES, Pirelli and Co., of Via Fabio Filzi 21, Milan, Italy.

An electric cable system, according to the present invention, comprises cables insulated with paper or textile material impregnated with oil having a viscosity not exceeding 6 Engler degrees at a temperature of 60 deg. Cent. The cables are provided with longitudinal tubular cavities, filled with the oil, and

Nº 251,670



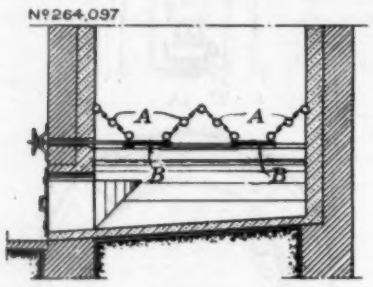
oil tanks or feeders A B C are arranged at predetermined distances along the cable and they communicate with the cavities in the cable by means of tubes, whereby the paper or textile insulation is maintained wholly and perfectly impregnated at all points. The oil may also be kept under pressure by compressors, which may also serve as feeding tanks. The tanks and compressors

may be combined with junction-boxes. At the lower end of the sloping cable shown electrical connection to the next section of the cable is made within a junction-box D.—*January 13th*, 1927.

FURNACES.

264,097. September 24th, 1926.—WATER-COOLED ASHPITS, *Babcock and Wilcox, Ltd., Farringdon-street, London, E.C. 4.*

This invention is concerned with the cooling of the ash deposited in furnaces burning pulverised fuel. The cooling is effected by the circulation of water through the tubes A A, which are

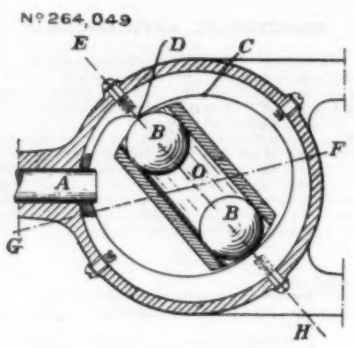


provided with fin radiators. The tubes are arranged so as to form a series of hoppers for the reception of the ash, which is dumped into the ashpit, as occasion may require, through the doors B B. In the interval these doors are closed to prevent the ingress of excess air into the furnace.—*January 13th*, 1927.

MACHINE TOOLS AND SHOP APPLIANCES.

264,049. April 23rd, 1926.—PERCUSSION TOOLS, G. E. Wagner, 36, Avenue de Rochetaillée, St. Etienne (Loire), France.

This tool is of the type in which a rapid rotary motion is converted directly into a series of blows on the working tool. The tool or its holder is shown at A, and the hammers in the form of balls at B B. During the greater part of their circumferential

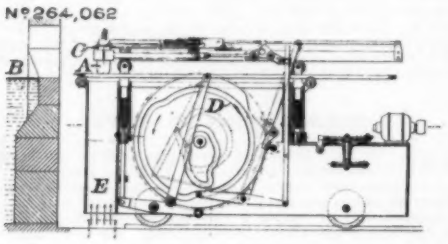


travel the balls are restrained as against centrifugal force by the cam C, but having passed the point D traverse a free trajectory until they strike the tool holder. It is stipulated in the specification that the curvature of the cam between the angles E O F and G O H should be symmetrical, while the curve in F O H must correspond with the trajectory of the ball, as it strikes the tool holder.—*January 13th*, 1927.

MISCELLANEOUS.

264,062. May 31st, 1926.—GLASS BOTTLE-MAKING MACHINE, Société Anonyme d'Etudes et de Constructions d'Appareils Mécaniques pour la Verrerie, 3, Rue de Castellane, Paris 8, France.

It would be futile to attempt to describe, in detail this complicated machine in the space here available, but it may be said that it is of the reciprocating type. The parison mould A is pushed forward into the furnace B and dipped into the molten



glass. A vacuum sucks the glass up into the mould which then retires again. The mould opens and the parison, hanging in the ring mould C, is transferred sideways to the finishing mould, in which it is blown to shape. The various movements are effected by a series of cams, one of which is shown at D. The moulds are cooled by a draught of air coming up the trunk E. There are fifteen figures in the specification.—*January 13th*, 1927.

THE INSTITUTION OF MINING ENGINEERS.—The summer meeting of the Institution of Mining Engineers will be held at Newcastle-upon-Tyne, by invitation of the president and Council of the North of England Institute of Mining and Mechanical Engineers, on Wednesday, Thursday and Friday, June 29th, 30th and July 1st next.

MILAN SAMPLE FAIR.—The eighth international Sample Fair is to be held at Milan from April 12th to 27th next. The Italian Chamber of Commerce in London, the address of which is 4, Queen Street-place, E.C. 4, has undertaken to act as official representative for the Fair and will give all information and assistance in its power both to manufacturers and to visitors, and in co-operation with the Italian State Touring Office in London—16, Waterloo-place, S.W. 1—will secure every possible facility for the journey to and accommodation in Milan.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Grand Hotel, Birmingham. Annual dinner. 6.30 for 7 p.m.

INSTITUTION OF ENGINEERING INSPECTION.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Economic Production of Steam by Electricity," by Mr. C. J. Wharton. 7.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: MANCHESTER CENTRE.—College of Technology, Manchester. Paper, "Modern Locomotive Superheating," by Mr. H. E. Geer. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Waste Heat Recovery," opened by Major W. Gregson. 7 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—No. 1 Committee Room, Town Hall, Manchester. North-Western District meeting. 2.45 p.m.

INSTITUTION OF PRODUCTION ENGINEERS.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Paper, "The Production of Cylinder Blocks in Quantities of 25, 250, and 2500 Per Week," by Mr. H. Mantell. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS, 39, Victoria-street, London, S.W. 1. Lecture, "A Trip in the Norwegian Fjords," by Dr. C. M. Walter. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—The Engineers' Club, Albert-square, Manchester. Paper, "Recent Developments in Machine Tools," by Messrs. G. E. Bailey and T. Smith. 7.15 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Literary and Philosophical Society's Rooms, Newcastle-upon-Tyne. Paper, "Loading and Unloading Facilities on Board Ship and Land," by Mr. R. J. Dodsworth. 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "The Solids of Plato and Archimedes," by Professor D'Arcy Thompson. 9 p.m.

TO-DAY TO FRIDAY, MARCH 4TH.

BRITISH INDUSTRIES FAIR.—Castle Bromwich, Birmingham, and White City, London. 10 a.m. each day.

SATURDAY, FEBRUARY 26TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—London Graduates' visit to the Service Station of Stewart and Ardern, Ltd., Acton Vale, W. 3. 2.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Students' visit to the reconstruction work at the grandstands at Epsom Racecourse.

MONDAY, FEBRUARY 28TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lecture: "Photo-elastic Measurements of Stress Distribution," by Professor E. G. Coker. 8 p.m.

SOCIETY OF CHEMICAL INDUSTRY.—Queen's Hotel, Leeds. Papers: "The Influence of Atmosphere and Temperature upon the Scaling of Steel: Part I., Scaling by Air, Water Vapour, and Carbon Dioxide," by Dr. C. B. Marson and Professor J. W. Cobb; "Part II., Prevention of Scaling by Hydrogen and Carbon Monoxide," by Dr. H. T. Angus and Professor J. W. Cobb; "A Thermal Study of the Process of Manufacture of Water Gas," by Dr. A. Parker; "A Study of Coke Formation," by Mr. R. A. Mott; "Coke in Relation to Some of its Industrial and Domestic Uses," by Mr. H. Hollings; "The Behaviour of Cokes in the Open Grate," by Margaret F. Bligh and Mr. H. J. Hodsman. 2.30 p.m.

TUESDAY, MARCH 1ST.

ELECTRICAL POWER ENGINEERS' ASSOCIATION: MIDLAND DIVISION.—Chamber of Commerce, New-street, Birmingham. Lecture, "Super-Tension Cables," by Mr. Charles Vernier. 7 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-upon-Tyne. Annual general meeting. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Some Notes on Petrol Engine Development," by Mr. H. R. Ricardo. 7.45 p.m.

WEDNESDAY, MARCH 2ND.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Students' meeting. Paper, "The Construction of a Large Cleaning Shed for Electric Trains," by Mr. L. G. Baynes Rock. 6.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. Paper, "Short Wave Wireless Telegraphy," by Mr. T. L. Eckersley. 6 p.m.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Caxton Hall, Caxton-street, London, S.W. 1. Discussion on paper, "The Effect of Weather Conditions upon the Heat Requirements of a House," by Dr. Margaret Fishenden. 7 p.m.

LIVERPOOL ENGINEERING SOCIETY.—9, The Temple, Dale-street, Liverpool. Paper, "The Mersey Crossings and Industrial Developments," by Mr. James Wilding. 6 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Corrosion of Metals at Joints and Crevices," by Mr. Ulick R. Evans. 8 p.m.

THURSDAY, MARCH 3RD.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—The Engineers' Club, Waterloo-street, Birmingham. "Metal Melting Furnaces," by Dr. E. W. Smith. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Papers: "Illuminating Engineering," by Mr. J. W. T. Walsh; and "The Problems of Public Lighting by Electricity," by Lieut.-Commander H. T. Harrison. 6 p.m.

FRIDAY, MARCH 4TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Cinematograph Exhibition. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Informal meeting. "An Evening with the Old Brigade." 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "Some Colouring Agents in Glasses and Glazes," by Sir Herbert Jackson. 9 p.m.

SATURDAY, MARCH 5TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Champness Hall, Drake-street, Rochdale. Lecture, "The Foundry Cupola," by Mr. W. H. Poole. 6.30 p.m.

MONDAY, MARCH 7TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: WESTERN CENTRE.—Merchant Venturers' Technical College, Bristol. Paper, "Some Notes on Petrol Engine Development," by Mr. H. R. Ricardo. 6.45 p.m.

TUESDAY, MARCH 8TH.

INSTITUTION OF AERONAUTICAL ENGINEERS.—Junior Institution of Engineers, 39, Victoria-street, London, S.W. 1. Paper, "Portable Hangars," by Major H. N. Wylie. 6.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Paper, "The Tansa Completion Works for the Water Supply of Bombay," by Mr. A. W. Stonebridge. 6 p.m.

WEDNESDAY, MARCH 9TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Utilisation of Gas Coke," by Dr. E. W. Smith, 8 p.m.

WEDNESDAY AND THURSDAY, MARCH 9TH AND 10TH.

INSTITUTE OF METALS.—Institution of Mechanical Engineers, Storey's-gate, London, S.W. 1. Annual general meeting. For programme see page 184. 10 a.m. each day.

INSTITUTION OF CHEMICAL ENGINEERS.—Burlington House, Piccadilly, London, W. 1. Conference. For programme see page 193.

FRIDAY, MARCH 11TH.

DIESEL ENGINE USERS ASSOCIATION.—Caxton Hall, Westminster, London, S.W. 1. Paper, "High-Revolution Oil Engines," by Mr. P. A. Holliday. 3 p.m.

EX-BRITISH WESTINGHOUSE ASSOCIATION.—Hotel Cecil, Strand, London, W.C. 2. Ninth re-union dinner. 5.45 for 6.45 p.m.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—Metallurgical Department of the University College, Singleton Park, Swansea. "The Influence of Oxygen on Copper and other Non-ferrous Metals," by Dr. F. Johnson. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—Liverpool Engineering Society's Rooms, The Temple, Dale-street, Liverpool. Paper, "Ships' Lifeboat Motors," by Mr. A. F. Evans. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Cupolas," by Mr. J. Wolstenholme. 7.30 p.m.

SATURDAY, MARCH 12TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South-Western District meeting at Bath. 12 noon.

MONDAY, MARCH 14TH.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Annual general meeting. "Moulding Sands," by Mr. G. Watt Tyrrell. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Chamber of Commerce, New-street, Birmingham. Joint meeting of the Birmingham and Wolverhampton Centres. Paper, "The High-tension Magneto, with Especial Reference to its Design, Manufacture and Service," by Messrs. A. P. Young and L. Griffiths. 7 p.m.

TUESDAY, MARCH 15TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—Municipal College, Ormerod-road, Burnley. Lecture, "The Mixing of Cast Iron, with Special Reference to Carbon, Silicon, Phosphorus, Manganese and Sulphur," by Mr. A. Buck. 7.15 p.m.

THURSDAY, MARCH 17TH.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Society of Motor Manufacturers and Traders' Rooms, 83, Pall Mall, London, S.W. 1. "The Works Chemist," by Mr. C. E. Barts. 7.30 p.m.

ANNUAL LONDON MOTOR PARADE.—The twenty-first annual London parade of commercial motor vehicles, organised by the Commercial Motor Users Association (Incorporated), with the object of encouraging drivers to take a personal interest in the driving and condition of their vehicles, and to run them without accident, will take place in Lincoln's Inn-fields on Saturday, March 26th, 1927, under the patronage of his Majesty the King. The *Commercial Motor* Challenge Cup will be awarded to the owner whose "team," in the opinion of the Judges' Committee, is in the best condition, having regard to the class of work upon which the units are employed, the ages of the machines, and the total distance run by them. The drivers of the winning team will be presented with the "Shrapnell-Smith" Challenge Cup and each driver will receive a cash award and a souvenir medal: the driver of each vehicle of the "runners-up" team will receive a cash award and a souvenir medal; the drivers of the third to the fortieth teams inclusive will receive a cash award or will be "highly commended." The British Electrical Development Association (Inc.) is co-operating with the C.M.U.A. in connection with the electric vehicle class of the parade, and special prizes will be awarded to the drivers of the winning vehicles in this class. Full particulars may be obtained on application to Mr. F. G. Bristow, F.C.I.S., general secretary, the Commercial Motor Users Association, 50, Pall Mall, S.W. 1.

WATERWORKS PUMPING PLANT OF THE CENTRIFUGAL TYPE.—Mather and Platt, Ltd., of Manchester and Park House, Great Smith-street, London, S.W. 1, have sent to us a well and tastefully got-up brochure describing a number of centrifugal pumping plants which they have supplied during recent years for various purposes in different parts of the country and abroad. This publication is far from being a catalogue; indeed it does not in the least resemble a catalogue. It consists of a series of remarkably well-illustrated brief references to a number of applications of centrifugal pumps to a variety of needs. We cannot afford space to do more than enumerate some of the installations dealt with. They are: (*a*) The Mullick Ghat pumping station of the Calcutta Corporation; (*b*) the Lostock booster station on the Thirlmere pipe line of the Manchester Corporation; (*c*) the river Don pumping scheme of the City of Sheffield; (*d*) the Cheddar pumping scheme of the Bristol Waterworks Company; (*e*) three pumping plants (Walton, Hampton, and Surbiton) of the Metropolitan Water Board; (*f*) a pumping scheme in North Lincolnshire; (*g*) the Belmont scheme for the Bolton Corporation waterworks; and (*h*) Milton pumping station of the South Staffordshire Waterworks. In addition there are particulars of other applications of centrifugal pumps, notably to deep wells and bore-holes, and to hydraulic installations. The plants chosen nearly all of them exhibit some novel feature, and they are referred to in clear and succinct language. The book, in fact, reflects great credit on its producers.